

# Industrial Seminar

**Industrial Seminar - Open to the public**..... Large Hall (2F)

Sunday, May 15 14:00 – 17:30

Chair: Noriko Kawakami, TMEIC

14:00 **Naoto Fujishima**

*Development Division, Semiconductors Business Group, Fuji Electric Co., Ltd.*  
"Technical Trend of Power Semiconductor Devices"



Naoto Fujishima

14:28 **Issei Takeuchi**

*Abstech Co., Ltd.*  
"System Abstraction Based on Element Description Method"



Issei Takeuchi

Chair: Seiichiro Katsura, Keio University

14:56 **Chieko Umeno**

*Toshiba Mitsubishi-Electric Industrial Systems Corporation*  
"Power Electronics Technology Contributing to Realization of Sustainable Society"



Chieko Umeno

15:40 **Ryohei Kitayoshi**

*YASKAWA Electric Corporation*  
"Vibration Suppression of Two Inertia System Using an Equivalent Rigid-body Observer"



Ryohei Kitayoshi

Chair: Kantaro Yoshimoto, Tokyo Denki University

16:08 **Akihiro Shibuya**

*Alliance PED, Powertrain and EV Engineering Division, Nissan Motor Co., Ltd.*  
"e-POWER technology in Nissan's electrification strategy"



Akihiro Shibuya

16:36 **Masaya Inoue**

*Mitsubishi Electric Corporation*  
"Development of a 48V Integrated Starter Generator for Mild Hybrid Vehicle"



Masaya Inoue

# Plenary Sessions

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## Plenary Session ..... Large Hall (2F)

Monday, May 16 9:00 - 10:45

Chair: Prof. Keiichiro Kondo (Vice co-chair, Steering Committee)

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9:00 **Prof. Seung Ki Sul**

*Seoul National University, Korea*

“Realistic Simulation of Traction Motors in the Power Train of Electric Vehicle”



Prof. Seung Ki Sul

Chair: Prof. Kan Akatsu (Chair, Steering Committee)

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9:35 **Prof. Zhengming Zhao**

*Tsinghua University, China*

“Discrete State Event-Driven Modeling and Simulation for Power Electronic Systems”



Prof. Zhengming Zhao

Chair: Prof. Hiroshi Fujimoto (Vice Co-chair, Program Committee)

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10:10 **Dr. Takahiro Mizoguchi**

*Motion Lib, Inc., Japan*

“Academic research results in use; a case in real-haptics”



Dr. Takahiro Mizoguchi

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**Tuesday, May 17** 16:55 - 18:40

Chair: Prof. Keiichiro Kondo (Vice Co-chair, Steering Committee)

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16:55 **Prof. Chris Gerada**

*University of Nottingham, UK*

“Advanced Electrical Machines and Drives for Net Zero Transport”



Prof. Chris Gerada

Chair: Prof. Hiroshi Fujimoto (Vice Co-chair, Program Committee)

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17:30 **Prof. Wen-Hua Chen**

*Loughborough University, UK*

“Nonlinear Disturbance Observer Design and Disturbance Observer-Based Control”



Prof. Wen-Hua Chen

Chair: Prof. Kan Akatsu (Chair, Steering Committee)

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18:05 **Prof. Rik W. De Doncker**

*Director E.ON Energy Research Center & Research Campus FEN, RWTH Aachen University*

“Power Electronics – a key enabling technology for the European Green Deal”



Prof. Rik W. De Doncker

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**Wednesday, May 18** 9:00 - 10:10

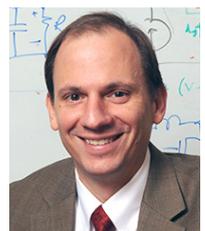
Chair: Prof. Keiji Wada (Vice Co-chair, Steering Committee)

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9:00 **Prof. David Perreault**

*Massachusetts Institute of Technology, USA*

“Opportunities, Progress and Challenges in Piezoelectric-Based Power Electronics”



Prof. David Perreault

Chair: Prof. Keiji Wada (Vice Co-chair, Steering Committee)

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9:35 **Prof. Tsorng-Juu Liang**

*National Cheng-Kung University, Taiwan*

“Implementation and Applications of Grid-forming Inverter with SiC for Power Grid Conditioning”



Prof. Tsorng-Juu Liang

# Introduction to MEXT Program Innovative Power Electronics Technologies

Monday, May 16 11:05 – 13:10 .....Large Hall (Room H)

Session Chairs : Toshihisa Shimizu(Tokyo Metropolitan University, Japan)

Masahiro Yamaguchi(Tohoku University, Japan)

Ko Matsumoto(Nagoya University, Japan)

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**Talk1 Tatsuo Oomori**

*Mitsubishi Electric Corporation, Japan*

Overview of MEXT-Program “Innovative Power-Electronics Technologies (INNOPEL)”

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**Talk2 Yoshikazu Takahashi<sup>1</sup>, Yoshitaka Iwaji<sup>2</sup>, Shuji Katoh<sup>1</sup>, Tetsuo Endoh<sup>1</sup>**

*1) Tohoku University, Japan, 2) Ibaraki University, Japan*

Integrated Power Electronics Technology for Decarbonized Society

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**Talk3 Yukihiro Sato, Hiroo Sekiya, Daisuke Miyagi, Hideo Saotome, Kenji Natori, Hiroyasu Kobayashi, Makoto Chiba**

*Chiba University, Japan*

Development of high-switching-frequency power converters with GaN power devices:  
From elemental technology to system design

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**Talk4 Satoshi Okamoto**

*Tohoku University, Japan*

Ultra-low loss magnetic materials for innovative power electronics

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**Talk5 Tsutomu Mizuno<sup>1</sup>, Toshiro Sato<sup>1</sup>, Kousuke Miyaji<sup>1</sup>, Makoto Sonehara<sup>1</sup>, Mitsuhide Sato<sup>1</sup>, Tsuyoshi Funaki<sup>2</sup>, Takaaki Ibuchi<sup>2</sup>, Shuhei Fukunaga<sup>2</sup>**

*1) Shinshu University, Japan, 2) Osaka University, Japan*

Development of transformers and inductors for high-frequency power conversion using magnetic anisotropic soft magnetic materials

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**Talk6-1 Hiroki Habazaki<sup>1</sup>, Hidenori Okuszaki<sup>2</sup>, Kazunori Hasegawa<sup>3</sup>, Shunzo Suematsu<sup>4</sup>**

*1) Hokkaido University, Japan, 2) Yamanashi University, Japan, 3) Kyushu Institute of Technology, Japan, 4) Nippon Chemi-Con Corporation, Japan*

Toward the development of novel capacitors for next-generation power electronics systems

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**Talk6-2 Hiroki Taniguchi<sup>1</sup>, Manabu Hagiwara<sup>2</sup>**

*1) Nagoya University, Japan, 2) Keio University, Japan*

Toward the development of novel capacitors for next-generation power electronics systems

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**Talk7 Hiroshi Amano, Jun Suda**

*Nagoya University, Japan*

Present Status and Future Prospects of GaN Vertical Power Devices

# Technical Sessions

Monday, May 16: 11:05-13:10

## Room A

### Session 16A1 Power and Energy Circuits and Systems for Communications (OS)

Chairs: Hiroo Sekiya (*Chiba University, Japan*)

Junrui Liang (*ShanghaiTech University, China*)

**16A1-1 A Self-powered Extensible SECE Rectifier For Piezoelectric Energy Harvesting**

*Invited Paper* Jiacong Qiu, Junrui Liang  
*ShanghaiTech University, China*

**16A1-2 Proposal for the Optimum Switching Frequency Search Method Based on Transmission Side Information of Wireless Power Transfer Circuit**

*Invited Paper* Taichi Mishima, Yuki Ito, Shingo Nagaoka, Takeshi Uematsu  
*OMRON Corporation, Japan*

**16A1-3 Energy Storage System with Intelligent Hot-plug Switch (IHS) Combined Use of Different Types of Batteries**

*Invited Paper* Kazuo Takehara<sup>1,2</sup>, Fumiaki Nakao<sup>1</sup>, Kimihiro Nishijima<sup>2</sup>, Eiji Sakai<sup>2</sup>  
1) *NEXTe Solutions Inc., Japan*, 2) *Sojo University, Japan*

**16A1-4 Performance Characteristics of 1500V Two Series Connection Type Converter**

*Invited Paper* Kazuhiro Kajiwara<sup>1</sup>, Yuji Ohta<sup>2</sup>, Ryuya Daimon<sup>1</sup>, Akio Segami<sup>2</sup>, Fujio Kurokawa<sup>1</sup>  
1) *Nagasaki Institute of Applied Science, Japan*, 2) *Isahaya Electronics Corporation, Japan*

**16A1-5 Optimized Energy Allocation Method Based on Capital Asset Pricing Model for Multi-use of Battery Energy Storage System**

*Invited Paper* Kazufumi Yuasa<sup>1</sup>, Yoshiharu Takeuchi<sup>2</sup>, Tadatoshi Babasaki<sup>2</sup>, Ichiro Omura<sup>1</sup>  
1) *Kyushu Institute of Technology, Japan*, 2) *NTT Facilities, Inc., Japan*

## Room B

### Session 16B1 Power Electronics and Motor Drives for Automobiles (OS)

Chairs: Kantaro Yoshimoto (*Tokyo Denki University, Japan*)

Masatoshi Uno (*Ibaraki University, Japan*)

**16B1-1 Magnetic Form applying a C-Shaped Magnet for Hybrid Electric Vehicles**

Shingo Soma, Yoshihisa Kubota, Tatsuya Ohzu  
*Honda motor Co., Ltd., Japan*

**16B1-2 Technology trends of automotive semiconductors for CASE application**

*Invited Paper* Hiroomi Eguchi  
*MIRISE Technologies Corporation, Japan*

**16B1-3 Control method of a dual inverter system for EV with one battery**

*Invited Paper* Tomonori Kimura<sup>1</sup>, Takahiro Yamada<sup>1</sup>, Ryoya Kazaoka<sup>2</sup>, Toshihiko Noguchi<sup>3</sup>  
1) *MIRISE Technologies Corporation, Japan*, 2) *DENSO CORPORATION, Japan*, 3) *Shizuoka University, Japan*

**16B1-4 Impact of Magnet Temperature Distribution on Output Capability of PMSM and its Estimation Methodology**

*Invited Paper* Kensuke Sasaki<sup>1</sup>, Atsushi Okada<sup>1</sup>, Takashi Kato<sup>1</sup>, Kan Akatsu<sup>2</sup>  
1) *Nissan Motor Co., Ltd, Japan*, 2) *Yokohama National University, Japan*

### **Session 16C1 Power Electronics for Enhancing Motion Control Systems (OS)**

**Chairs:** Kenji Natori (*Chiba University, Japan*)

Yuki Yokokura (*Nagaoka University of Technology, Japan*)

**16C1-1 Direct Torsion Torque Control of Geared SPMSM for Quick Backforward-Drivability**

*Invited Paper* Yuki Yokokura, Kiyoshi Ohishi  
*Nagaoka University of Technology, Japan*

**16C1-2 Effect of Harmonic Current Suppression on Iron Loss of IPMSM Using Repetitive Perfect Tracking Control**

*Invited Paper* Yuhiro Inagaki<sup>1</sup>, Masahiro Mae<sup>1</sup>, Osamu Shimizu<sup>1</sup>, Sakahisa Nagai<sup>1</sup>, Hiroshi Fujimoto<sup>1</sup>, Takayuki Miyajima<sup>2</sup>, Yoshiki Yasuda<sup>2</sup>, Akio Yamagiwa<sup>2</sup>  
1) *The University of Tokyo, Japan*, 2) *DAIKIN Industries, Ltd., Japan*

**16C1-3 A Study of 10MHz Multi-Sampling Deadbeat Control for PMSM Drive System using USPM Controller**

*Invited Paper* Daisuke Hiroe, Zhang Xiaohan, Ryosuke Suzuki, Kazuki Nakamura, Kotaro Sato, Kantaro Yoshimoto, Tomoki Yokoyama  
*Tokyo Denki University, Japan*

**16C1-4 PI Current Control Method for Realizing Deadbeat Characteristics**

*Invited Paper* Shota Kuroda, Kenji Natori, Yukihiro Sato  
*Chiba University, Japan*

**16C1-5 Circuit Architecture and Design of A Megahertz Wireless Power Transfer System for Drones**

*Invited Paper* Yaoxia Shao<sup>1</sup>, Ruihan Ma<sup>1</sup>, Huan Zhang<sup>1</sup>, Ming Liu<sup>2</sup>, Chengbin Ma<sup>1</sup>  
1) *University of Michigan-Shanghai Jiao Tong University Joint Institute, China*, 2) *Shanghai Jiao Tong University, China*

### **Session 16D1 Control and Analysis of Converters I**

**Chairs:** Ikuya Sato (*Fuji Electric Co., Ltd., Japan*)

Rolando Burgos (*Virginia Polytechnic Institute and State University, USA*)

**16D1-1 Capacitor-Voltage-Balancing Control for an Isolated Secondary-Resonant AC-DC Modular Matrix Converter**

Kohei Budo, Takaharu Takeshita  
*Nagoya Institute of Technology, Japan*

**16D1-2 Statistical Performance Verification of the FS-MPC Algorithm Applied to the Matrix Converter**

Mateja Novak<sup>1</sup>, Iwona Grobelna<sup>2</sup>, Ulrik Nyman<sup>1</sup>, Pawel Szczesniak<sup>2</sup>, Frede Blaabjerg<sup>1</sup>  
1) *Aalborg University, Denmark*, 2) *University of Zielona Gora, Poland*

**16D1-3 A Unified PWM Strategy to Reduce Minimum Switching Number for Matrix Converters**

Pailboon Kiatsookkanatorn<sup>1</sup>, Somboon Sangwongwanich<sup>2</sup>  
1) *Rajamangala University of Technology Suvarnabhumi, Thailand*, 2) *Chulalongkorn University, Thailand*

**16D1-4 Adjustable Carrier Phase Shift Operation of Switching Cycle Control for Modular Multilevel Converters**

Jayesh Kumar Motwani, Boran Fan, Slavko Mocevic, Jianghui Yu, Yu Rong, Dushan Boroyevich, Dong Dong, Rolando Burgos  
*Virginia Tech, USA*

**16D1-5 A New Control Method to Realize Wide Output Voltage Range for Three Phase AC/DC Converter Based on Matrix Converter**

Kazuma Tomida<sup>1</sup>, Kenji Natori<sup>1</sup>, Jin Xu<sup>2</sup>, Noboru Shimosato<sup>2</sup>, Yukihiro Sato<sup>1</sup>  
1) *Chiba University, Japan*, 2) *Myway Plus Corporation, Japan*

## **Session 16E1 Grid Forming Converters I**

**Chairs:** Yuko Hirase (*Toyo University, Japan*)

Chen Zhang (*Shanghai Jiaotong University, China*)

- 16E1-1 Improved Adaptive Inertia and Damping Coefficient Control Strategy of VSG Based on Optimal Damping Ratio**  
Qingyi Wang<sup>1,2,3</sup>, Dan Zhou<sup>1,2,3</sup>, Shuai Yin<sup>1,2,3</sup>, Yudi Lei<sup>1,2,3</sup>, Tao He<sup>1,2,3</sup>  
1) *China University of Geosciences, China*, 2) *Hubei Key Laboratory of Advanced Control and Intelligent Automation for Complex Systems, China*, 3) *Ministry of Education, China*
- 16E1-2 A Study on Emulated Inertia Control of Grid-Connected Inverter-Based Power Supply Sources for Mass Integration of Renewable Energy Resources**  
Hirofumi Uemura<sup>1</sup>, Sachio Takano<sup>1</sup>, Atsushi Harada<sup>1</sup>, Takahiro Matsuura<sup>2</sup>, Satoshi Miyazaki<sup>2</sup>, Hiromu Hamada<sup>2</sup>, Teru Miyazaki<sup>2</sup>  
1) *Fuji Electric Co., Ltd., Japan*, 2) *Tokyo Electric Power Company Holdings, Inc., Japan*
- 16E1-3 Uninterrupted Switching based on VSG Control between Grid-connected and Stand-alone Operation of Single-Phase Grid-Tied Inverter**  
Kodai Nishikawa, Keisuke Kusaka, Jun-ichi Itoh  
*Nagaoka University of Technology, Japan*
- 16E1-4 The Effects of Virtual Inertia Control on Power Converters in Nonideal Grid Conditions**  
Yang Haoxin<sup>1</sup>, Tang Yi<sup>1</sup>, Zhang Lei<sup>2</sup>  
1) *Nanyang Technological University, Singapore* 2) *Chengdu Technological University, China*
- 16E1-5 Influence of DC Network Impedance and Control Parameters on Stability of Grid-tied Converters with LCL Filter Analyzing from DC Side**  
Ravi Kumar Gaddala, Siddavatam Ravi Prakash Reddy, Mriganka Ghosh Majumder, Kaushik Rajashekara, Lobo da Fonseca Jean Marcos  
*University of Houston, USA*

## **Session 16F1 Reliability and Diagnostics of Power Converters I**

**Chairs:** Takushi Jimichi (*Mitsubishi Electric Corporation, Japan*)

Lee Chia-Tse (*Delta Electronics Inc., Taiwan*)

- 16F1-1 Identification Method for Various Failure Modes with Shared Kelvin and Power Wires Configuration in IGBT Power Modules**  
Qiang Wu<sup>1</sup>, Yu Chen<sup>1</sup>, Haoze Luo<sup>1</sup>, Jian Zhang<sup>1</sup>, Wuhua Li<sup>1</sup>, Xiangning He<sup>1</sup>, Naoto Fujishima<sup>2</sup>, Haruhiko Nishio<sup>2</sup>, Hitoshi Sumida<sup>2</sup>  
1) *Zhejiang University, China*, 2) *Fuji Electric Co., Ltd., Japan*
- 16F1-2 Failure Mechanism Investigation of Die-Attach Solder Based on the Birth and Death Technology**  
Zhiliang Xu, Qianxia Ke, Xinglai Ge, Huimin Wang, Zongyuan Dai  
*Southwest Jiaotong University, China*
- 16F1-3 Mission-Profile Based Reliability Analysis Scheme of IGBT Modules for Traction Rectifier**  
Qianxia Ke, Zhiliang Xu, Xinglai Ge, Qingli Deng, Huiming Wang, Linlin Zhang, Jin Li  
*Southwest Jiaotong University, China*
- 16F1-4 Reliable design of SiC MOSFET power modules: experimental characterization for aging prediction**  
Shuhei Fukunaga<sup>1</sup>, Alberto Castellazzi<sup>2</sup>, Tsuyoshi Funaki<sup>1</sup>  
1) *Osaka University, Japan*, 2) *Kyoto University of Advanced Science, Japan*
- 16F1-5 Continuous Operation of High-Power Half-Bridge with 12 Paralleled GaN Power Devices**  
Takashi Sawada<sup>1</sup>, Hiroshi Tadano<sup>2</sup>, Koji Shiozaki<sup>2</sup>, Takanori Isobe<sup>3</sup>  
1) *Naturanix Co., Ltd., Japan*, 2) *Nagoya University, Japan*, 3) *University of Tsukuba, Japan*

### **Session 16G1 Wireless Power Transfer I**

**Chairs:** Mami Mizutani (*Toshiba Infrastructure Systems & Solutions Corporation, Japan*)

Yijie Wang (*Harbin Institute of Technology, China*)

- 16G1-1 A Novel Driving Scheme for Inductive Power Transfer Systems Using Decoupled Transmitter Coils**  
Kai Zhao, Minfan Fu, Guangdong Ning, Rong He, Hengzhao Yang, Haoyu Wang  
*ShanghaiTech University, China*
- 16G1-2 Effect of Angle Offset of the Power Receiving Coil in Underwater Wireless Power Transfer Using a Cone Spiral Coil**  
Suguru Mototani, Ryo Yamamoto, Kae Doki, Akihiro Torii  
*Aichi Institute of Technology, Japan*
- 16G1-3 Analysis and Design of a Wide Air Gap IPT System with Multi-Load CV Characteristics Based on Cylindrical Solenoid Coupler**  
Yijie Wang, Zhimin Liu, Peng Gu, Dianguo Xu  
*Harbin Institute of Technology, China*
- 16G1-4 Feasibility Study on Wireless Power Transfer for AUV with Novel Pressure-Resistant Ceramic Materials**  
Haibing Wen, Jiayuan Li, Lei Yang, Xiangqian Tong  
*Xi'an University of Technology, China*
- 16G1-5 Stability Analysis of Flying-capacitor Linear Amplifier for Wireless Power Transfer system**  
Rintaro Kusui, Keisuke Kusaka, Jun-ichi Itoh  
*Nagaoka University of Technology, Japan*

**Monday, May 16: 14:10-16:15**

### **Session 16A2 Data Driven Methods in Power Electronics Systems: Applications in Analysis and Stability (OS)**

**Chairs:** Marta Molinas (*Norwegian University of Science and Technology, Norway*)

Chen Zhang (*Shanghai Jiao Tong University, China*)

- 16A2-1 Impedance Model Identification of DFIG-Based Wind Turbine Based on Neural Network**  
*Invited Paper* Zhong Wang, Jing Lyu, Xu Cai  
*Shanghai Jiao Tong University, China*
- 16A2-2 Instability Mode Recognition of Grid-Tied Voltage Source Converters with Nonstationary Signal Analysis**  
*Invited Paper* Yu Zhang<sup>1</sup>, Sjur Føyen<sup>2</sup>, Chen Zhang<sup>1</sup>, Marta Molinas<sup>2</sup>, Olav Bjarte Fosso<sup>2</sup>, Xu Cai<sup>1</sup>  
1) *Shanghai Jiao Tong University, China*, 2) *Norwegian University of Science and Technology, Norway*
- 16A2-3 Impedance-Based Stability Analysis of Systems with the Dominant Presence of Distributed Power Sources**  
*Invited Paper* Kazuki Ohuchi<sup>1</sup>, Yuko Hirase<sup>1</sup>, Marta Molinas<sup>2</sup>  
1) *Toyo University, Japan*, 2) *Norwegian University of Science and Technology, Norway*
- 16A2-4 Impedance scanning with chirps for single-phase converters**  
*Invited Paper* Sjur Foyen<sup>1</sup>, Chen Zhang<sup>2</sup>, Marta Molinas<sup>2</sup>, Olav Fosso<sup>1</sup>, Takanori Isobe<sup>3</sup>  
1) *Norwegian University of Science and Technology, Norway*, 2) *Shanghai Jiao Tong University, China*, 3) *University of Tsukuba, Japan*
- 16A2-5 Mechanism and Suppression Control of Wideband Oscillations in MMC-HVDC Connected Offshore Wind Farms**  
*Invited Paper* Jing Lyu, Hongfei Lin, Yiming Rao, Xu Cai  
*Shanghai Jiao Tong University, China*

## **Session 16B2 Achievements and Findings from Vehicle Grid Integration Project and Research (OS)**

**Chairs:** Masatoshi Uno (*Ibaraki University, Japan*)

Kensuke Sasaki (*Nissan Motor Co., Ltd., Japan*)

### **16B2-1 Frequency Adjustment with Integrated Control of EVs and Storage Batteries**

*Invited Paper* Takehiko Ashiya<sup>1</sup>, Ayumu Izuhara<sup>1</sup>, Koji Kudo<sup>2</sup>

1) *Kansai Transmission and Distribution, Inc., Japan*, 2) *NEC Corporation, Japan*

### **16B2-2 Charging infrastructure - how to contribute to the power grid -**

*Invited Paper* Makoto Yoshida<sup>1</sup>, Osamu Maruta<sup>1</sup>, Tomoko Blech Yamabe<sup>2</sup>, Mika Zaurin Casanova<sup>2</sup>

1) *CHAdeMO Association, Japan*, 2) *CHAdeMO Association, France*

### **16B2-3 Frequency Control for AC Microgrid Using Onboard DC/DC Converter of Electric Vehicles**

*Invited Paper* Tatsuhito Nakajima<sup>1</sup>, Yutaka Ota<sup>2</sup>, Takuya Ishikawa<sup>3</sup>, Kazumasa Ide<sup>3</sup>

1) *Tokyo City University, Japan*, 2) *Osaka University, Japan*, 3) *Hitachi Power Solutions Co., Ltd., Japan*

### **16B2-4 Evaluation of Electric Vehicles (EVs) Impact on Electric Grid**

*Invited Paper* Inam Ullah Nutkani, Jing Cheng Lee

*RMIT University, Australia*

## **Session 16C2 Sensing and Actuation for Human Assistive Systems (OS)**

**Chairs:** Naoki Motoi (*Kobe University, Japan*)

Tomoyuki Shimono (*Yokohama National University, Japan*)

### **16C2-1 Safe High Stiffness Impedance Control for Series Elastic Actuators using Collocated Position Feedback**

*Invited Paper* Razvan Andrei Budau Petrea, Roberto Oboe, Giulia Michieletto

*University Of Padova, Italy*

### **16C2-2 Study on Disturbance Response of a Magnetic Lead Screw Actuator**

*Invited Paper* Akira Heya<sup>1</sup>, Yoshihiro Nakata<sup>2</sup>, Tetsuya Abe<sup>1</sup>, Katsuhiro Hirata<sup>1</sup>

1) *Osaka University, Japan*, 2) *The University of Electro-Communications, Japan*

### **16C2-3 Modeling and Analysis of a Magnetic Geared Linear Motor**

*Invited Paper* Nguyen Duc Khuong<sup>1</sup>, Tomoyuki Shimono<sup>1,2</sup>

1) *Yokohama National University, Japan*, 2) *Kanagawa Institute of Industrial Science and Technology, Japan*

### **16C2-4 Study on Displaying Images to Prevent VR Sickness as Maintaining Rich-Presence**

*Invited Paper* Satoshi Okuno, Sota Shimizu

*Shibaura Institute of Technology, Japan*

### **16C2-5 Path Planning Method Considering Blind Spots Based on ROS Navigation Stack and Dynamic Window Approach for Wheeled Mobile Robot**

*Invited Paper* Masato Kobayashi, Naoki Motoi

*Kobe University, Japan*

## **Session 16D2 IoT Technologies for Realizing Smart Facilities (OS)**

**Chairs:** Shinobu Ishigami (*Tohoku Gakuin University, Japan*)

Nobuyuki Yamaguchi (*Tokyo University of Science, Japan*)

### **16D2-1 Selective Allocation Management System of Environmental Value and Electric Power Consumption**

*Invited Paper* Hiroki Oshima, Keishi Ooshima, Yoshihiro Machida, Masashi Amano, Takayuki Suzuki, Hiroshi Mine,

Ko Takahashi, Kazuya Syojiki, Masahiro Aoki

*Hitachi, Ltd., Japan*

### **16D2-2 Simulation of Energy Management Considering Remote Work of Office Buildings With Storage Batteries in the Case of Disaster**

*Invited Paper* Kazuhiro Yuasa<sup>1</sup>, Sota Kinoshita<sup>1</sup>, Nobuyuki Yamaguchi<sup>1</sup>, Fuyuki Sato<sup>2</sup>, Shinichiro Ohtani<sup>2</sup>

1) *Tokyo University of Science, Japan*, 2) *Mitsubishi Electric Corporation, Japan*

**16D2-3 SUSTIE Core Engine: Efficient IoT Platform for Smart Facility Solutions**

*Invited Paper* Jin Kawasaki, Yoshitaka Otaki, Keita Saito, Hiroki Kawano  
*Mitsubishi Electric Corporation, Japan*

**16D2-4 Proposal of the theoretical conversion factor for the interpolation of measured radiated emission levels**

*Invited Paper* Shinobu Ishigami<sup>1</sup>, Tatsuru Itsukaichi<sup>1</sup>, Ken Kawamata<sup>1</sup>, Yasutoshi Yoshioka<sup>2</sup>  
1) *Tohoku Gakuin University, Japan*, 2) *Fuji Electric Europe GmbH, Germany*

**16D2-5 Unsupervised Fault Detection for Refrigeration Showcase Systems with Kernel Principal Component Analysis based Multivariate Statistical Process Control using Feature Selection with Maximal Information Coefficient**

Kiyo Arai<sup>1</sup>, Yoshikazu Fukuyama<sup>2</sup>, Kenya Murakami<sup>1</sup>, Tetsuro Matsui<sup>1</sup>  
1) *Fuji Electric Co., Ltd., Japan*, 2) *Meiji University, Japan*

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**Room E**

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**Session 16E2 Control and Analysis of Converters II**

**Chairs:** Hidemine Obara (*National Yokohama University, Japan*)

Kantoaro Yoshimoto (*Tokyo Denki University, Japan*)

**16E2-1 Harmonic Calculation of Parallel Interleaved Voltage-Source Converters in Digital Systems**

Haozhe Wang, Jie Ye, Baojin Li, Songtao Huang, Jinbang Xu, Anwen Shen  
*Huazhong University of Science and Technology, China*

**16E2-2 A New Trapezoidal Modulation Technique to Reduce Acoustic Noise**

Hideki Ayano<sup>1</sup>, Takumi Nakagaki<sup>1</sup>, Yushi Araki<sup>2</sup>, Tatsuki Kashihara<sup>2</sup>, Koji Kobayashi<sup>2</sup>  
1) *National Institute of Technology, Japan*, 2) *SANDEN CORPORATION, Japan*

**16E2-3 Frequency-Doubler Half-Bridge Modulation For Reduced Junction Temperatures in the Low-Gain Operation of the Isolated Full-Bridge Converter**

Philipp Rehlaender, Shobhit Sharma, Frank Schafmeister, Joachim Böcker  
*Paderborn University, Germany*

**16E2-4 Verification of 1MHz Multisampling Disturbance Compensation Deadbeat Control for Megawatt-Level Grid-Tied Multi-level Inverter using Controller Hardware-in-the-Loop**

Ryoko Kato<sup>1</sup>, Kazuki Nakamura<sup>1</sup>, Kaya Kawashima<sup>1</sup>, Kohsuke Seki<sup>2</sup>, Kenta Yamabe<sup>2</sup>, Kantaro Yoshimoto<sup>1</sup>, Tomoki Yokoyama<sup>1</sup>  
1) *Tokyo Denki University, Japan*, 2) *Tohiba Mitsubishi-Electric Industrial Systems Corporation, Japan*

**16E2-5 A Data Modulation Strategy Based on LLC Resonant Converter**

Lingyu Li, Sheng Liu, Jinghui Chen, Jiande Wu, Xiangning He  
*Zhejiang University, China*

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**Room F**

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**Session 16F2 Non-isolated DC-DC Converters**

**Chairs:** Masataka Ishihara (*Okayama University, Japan*)

Yao-Ching Hsieh (*National Sun Yat-sen University, Taiwan*)

**16F2-1 Performance of Three-phase Inverter Using Multiple Bidirectional Choppers for 1.5-kV PV Systems Capable of Wide MPPT Range**

Linyue Qiao, Makoto Hagiwara  
*Tokyo Institute of Technology, Japan*

**16F2-2 Internal Reference Compensation Technique for Constant On-time Buck Converter with Ceramic Capacitor**

Pang-Jung Liu<sup>1</sup>, Chi-Hung Wang<sup>1</sup>, Mao-Hui Kuo<sup>2</sup>, Xin-Wei Huang<sup>1</sup>  
1) *National Taipei University of Technology, Taiwan*, 2) *Richtek Technology Corporation, Taiwan*

**16F2-3 Charge Equalization with Differential Current Allocation for Series-connected Batteries**

Liang-Chien Lin<sup>1</sup>, Cheng-Xiu Xie<sup>1</sup>, Tzu-Hsiang Weng<sup>2</sup>, You-Chun Huang<sup>2</sup>, Yao-Ching Hsieh<sup>2</sup>, Chin-Sien Moo<sup>2</sup>  
1) *Delta Electronics Inc., Taiwan*, 2) *National Sun Yat-sen University, Taiwan*

**16F2-4 Boost Derived Full-Bridge ZCS Resonant Converter Using Inductive Output Filter**

Somboon Sooksatra, Wanchai Subsingha  
*Rangsit University Pathumthani, Thailand*

### **Session 16G2 PMSM Sensorless Drives**

**Chairs:** Takayuki Miyajima (*Daikin Industries, Ltd., Japan*)

Kichiro Yamamoto (*Kagoshima University, Japan*)

- 16G2-1 Performance Evaluation of Startup and Driving Strategy at Overall Speed with Extended ElectroMotive Force for Position Sensorless Permanent Magnet Synchronous Motor**  
Rongjiao Hao, Takamasa Kozakura, Shinji Doki  
*Nagoya University, Japan*
- 16G2-2 Compensation of Zero Current Clamping Phenomenon of Sensorless IPMSM Drives with Ultrasonic Signal Injection**  
Hisao Kubota, Naoya Hayashi  
*Meiji University, Japan*
- 16G2-3 Sensorless PMSM Harmonic Suppression Strategy Based on PLL with Embedded Double Quasi-Proportional-Resonant Controllers**  
Bo Wang, Pengcheng Du, Yong Yu, Dianguo Xu  
*Harbin Institute of Technology, China*
- 16G2-4 Harmonic Reduction Method Using Minor Sampling Process for Signal Injection Position Sensorless Technique**  
Yuki Ito, Yoshitaka Iwaji  
*Ibaraki University, Japan*
- 16G2-5 Parameter Estimation for Sensorless Position Control of PMSM Drives with Long Cable in Subsea Applications**  
Virendra Singh, Mriganka Ghosh Majumder, Kaushik Rajashekara, Ravi Prakash Reddy Siddavatam  
*University of Houston, USA*

### **Session 16H2 Special machines**

**Chairs:** Makoto Ito (*Hitachi, Ltd., Japan*)

Jihad Furqani (*Bandung Institute of Technology, Indonesia*)

- 16H2-1 Three-Phase Air-Core Rotary Transformer with Halbach AC Windings for Wound-Field Motors**  
Masahiro Aoyama  
*Shizuoka University, Japan*
- 16H2-2 Design of Slotless Single-Drive Bearingless Permanent Magnet Motor for High-Speed Applications**  
Junichi Asama  
*Shizuoka University, Japan*
- 16H2-3 Estimation of Magnetic Suspension Loss in a 30000 r/Min One-Axis Actively Positioned Single-Drive Bearingless Motor**  
Theeraphong Srichiangsa<sup>1</sup>, Hiroya Sugimoto<sup>2</sup>, Yusuke Fujii<sup>1</sup>, Kyohei Kiyota<sup>1</sup>, Akira Chiba<sup>1</sup>  
1) *Tokyo Institute of Technology, Japan*, 2) *Tokyo Denki University, Japan*
- 16H2-4 Development of Direct Cooling Stator Structure Using High Thermal Conductive Epoxy Molding Compounds**  
Shinya Yamamoto, Atsunori Nishikawa, Takahiro Harada, Wataru Kosaka  
*SUMITOMO BAKELITE CO., LTD., Japan*
- 16H2-5 PM Magnetic Levitation Train Using Hybrid Electromagnetic- and Electrodynamic-Suspension System**  
Shun Inoue, Yasutaka Fujimoto  
*Yokohama National University, Japan*

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Room A

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**Session 16A3 Grid Forming Converters II**

Chairs: Shinichi Imai (*Takaoka Toko Co., Ltd., Japan*)

Frede Blaabjerg (*Aalborg University, Denmark*)

- 16A3-1 Stability Analysis of Grid-Following and Grid-Forming Converters Based on State-Space Model**  
Xian Gao, Dao Zhou, Amjad Anvari-Moghaddam, Frede Blaabjerg  
*Aalborg University, Denmark*
- 16A3-2 Impact of Circular Current Limiters on Transient Stability of Grid-Forming Converters**  
Bo Fan, Xiongfei Wang  
*Aalborg University, Denmark*
- 16A3-3 Impact of DC-Link Voltage Control on Transient Stability of PLL-Synchronized Voltage-Source Converters**  
Teng Liu<sup>1</sup>, Xiongfei Wang<sup>1</sup>, Fangcheng Liu<sup>2</sup>  
1) *Aalborg University, Denmark*, 2) *Huawei Digital Power Technologies Company Ltd., China*
- 16A3-4 Design-Oriented Analysis of Grid-Forming Control with Hybrid Synchronization**  
Hong Gong, Xiongfei Wang  
*Aalborg University, Denmark*

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Room B

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**Session 16B3 Thermal Management**

Chairs: Koji Orikawa (*Hokkaido University, Japan*)

Jonas Huber (*ETH Zurich, Switzerland*)

- 16B3-1 On-line Junction Temperature Estimation Method of Power Device with Deterioration Based on On-state Voltage Measurement**  
Hayato Higa<sup>1</sup>, Takanori Hayashi<sup>1</sup>, Masashi Takiguchi<sup>1</sup>, Shota Urushibata<sup>1</sup>, Yugo Tadano<sup>1</sup>  
1) *Meidensha Corporation, Japan*
- 16B3-2 Estimation of Both Junction Temperature and Load Current of IGBTs from Output Voltage of Gate Driver**  
Hiromu Yamasaki, Katsuhiro Hata, Makoto Takamiya  
*The University of Tokyo, Japan*
- 16B3-3 Junction Temperature Estimation for IGBT Modules Through Knee Voltage**  
Xing Wei, Bo Yao, Yingzhou Peng, Huai Wang  
*Aalborg University, Denmark*
- 16B3-4 Temperature Sensorless Thermal Management Strategy for Interleaving Power Converters**  
Zehui Li, Mingde Zhou, Haoyu Wang  
*ShanghaiTech University, China*

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Room C

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**Session 16C3 GaN Device Application**

Chairs: Katsuya Nomura (*Kwansei Gakuin University, Japan*)

Jens Friebe (*Leibniz University Hannover, Germany*)

- 16C3-1 Efficiency Improving Strategies on GaN-based LLC Converter with Non-uniform Air Gap Transformer**  
Ching-Guo Chen<sup>1</sup>, Shiu-Hui Lee<sup>2</sup>, Wen-Nan Huang<sup>1</sup>, Chih-Ming Yu<sup>1</sup>, Hsiang-Chi Meng<sup>1</sup>  
1) *Potens Semiconductor Corp., Taiwan*, 2) *National Taipei University of Technology, Taiwan*
- 16C3-2 Multi-Mode Control with GaN High Operating Frequency Four-Switch Step-Up/Down Converter**  
Jiann-Fuh Chen, Zih-Yue Chen, Chen-Ming Zhang  
*National Cheng Kung University, Taiwan*

**16C3-3 Parasitic Effects from Cooling of GaN Power Transistors - Impact on Switching Losses and Common-Mode Currents**

Pelle Weiler, Bart Bokmans, Erik Lemmen, Bas Vermulst, Korneel Wijnands  
*Eindhoven University of Technology, The Netherlands*

**16C3-4 GaN-based High Frequency NIBB dc-dc Converter with Feedback Control Using FPGA**

Ravi Nath Tripathi, Alberto Castellazzi  
*Kyoto University of Advanced Science (KUAS), Japan*

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**Room D**

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**Session 16D3 Industrial Instrumentation and Control I**

**Chairs:** Yasutaka Fujimoto (*Yokohama National University, Japan*)

Naoki Motoi (*Kobe University, Japan*)

**16D3-1 Accurate Ion Energy Control in Plasma Processing by Switched-Mode Power Converter**

Qihao Yu, Erik Lemmen, Korneel Wijnands, Bas Vermulst  
*Eindhoven University of Technology, The Netherlands*

**16D3-2 Optimization Approaches for the Signal Processing of Hybrid Current Sensors**

Philipp Ziegler, Michael Bura, Jörg Haarer, Philipp Marx, David Hirning, Jörg Roth-Stielow  
*University of Stuttgart, Germany*

**16D3-3 Design and Control of Single-Phase Controlled VSCs with Saturable Inductor-Based LCL Filters**

Ziya Özkan, Dao Zhou, Frede Blaabjerg  
*Aalborg University, Denmark*

**16D3-4 A VSD-Embedded Machine Learning Misalignment and Unbalance Diagnosis Methodology**

Saïd Talbi<sup>1</sup>, Alain Dutrey<sup>2</sup>  
*1) Médiante Système for STIE, France, 2) Schneider Toshiba Inverter Europe, France*

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**Room E**

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**Session 16E3 DC-DC Converters I**

**Chairs:** Kantaro Yoshimoto (*Tokyo Denki University, Japan*)

Yu-Chen Liu (*National Ilan University, Taiwan*)

**16E3-1 Multi-stage charging strategy with constant resonant current of LCC resonant circuit**

Mengjie Qin, Aizhen Ye, Fan Zhang, Wenjie Chen, Xu Yang, Yao Xiao  
*Xi'an Jiaotong University, China*

**16E3-2 Analysis and Comparison of Isolated Converter based Step-Down Partial Power Processing Configurations**

Chao Liu, Zhe Zhang, Ziwei Ouyang, Michael A. E. Andersen, Tiberiu-Gabriel Zsurzsan  
*Technical University of Denmark, Denmark*

**16E3-3 1.5-MHz High-Performance 380-V/12-V LLC Resonant Converter**

Yun-Yen Chen<sup>1</sup>, Yu-Chen Liu<sup>2</sup>, Chen Chen<sup>1</sup>, Kai-De Chen<sup>1</sup>, Yong-Long Syu<sup>1</sup>, Wen-Hao Xue<sup>1</sup>, Huang-Jen Chiu<sup>1</sup>  
*1) National Taiwan University of Science and Technology, Taiwan, 2) National Ilan University, Taiwan*

**16E3-4 Secondary-Side Resonating LLC Converter for Reducing Transformer Voltage in High Power Applications**

Hayato Nakamura<sup>1</sup>, Kazuhiro Umetani<sup>1</sup>, Masataka Ishihara<sup>1</sup>, Eiji Hiraki<sup>1</sup>  
*Okayama University, Japan*

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**Room F**

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**Session 16F3 Control and Analysis of Modular Multi-level Converters**

**Chairs:** Hirofumi Uemura (*Fuji Electric Co., Ltd., Japan*)

Georgios Konstantinou (*The University of New South Wales, Australia*)

**16F3-1 Impedance Shaping Effects of Circulating Current Controllers in Modular Multilevel Converters**

Ye Zhu<sup>1</sup>, Josep Pou<sup>2</sup>, Georgios Konstantinou<sup>1</sup>  
*1) University of New South Wales, Australia, 2) Nanyang Technological University, Singapore*

- 16F3-2 Non-Linear Model Predictive Control for Modular Multilevel Converters**  
 Saad Hamayoon<sup>1</sup>, Morten Hovd<sup>1</sup>, Jon Are Suul<sup>1,2</sup>  
 1) Norwegian University of Science and Technology, Norway, 2) SINTEF Energy Research, Norway
- 16F3-3 A Study of 1MHz Multi-Sampling SVPWM Method for Low Carrier Three Phase Modular Multilevel Converter**  
 Kotaro Sato, Kazuki Nakamura, Sakyo Takeuchi, Tomoki Yokoyama  
 Tokyo Denki University, Japan

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## Room G

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### Session 16G3 Special Motor Drives

**Chairs:** Takahiro Suzuki (*Hitachi Ltd., Japan*)  
 Ufot Ekong (*TMEIC, Japan*)

- 16G3-1 Predictive Control of Sensorless Flux-Switching Motor Drive Systems with DC-Field Excitation**  
 Tian-Hua Liu, Yu-Hao Xu  
 National Taiwan University of Science and Technology, Taiwan
- 16G3-2 Stability Improvement Method of Position Sensorless Control for Single Inverter Dual Parallel IPMSMs Drive System by Using Signal Injection**  
 Cheonsu Park, Shinji Doki  
 Nagoya University, Japan
- 16G3-3 Characteristic Evaluation of Linear Switched Reluctance Motor with High-temperature Superconducting Excitation Windings for Application to Ropeless Linear Elevator**  
 Tadashi Hirayama, Shuma Kawabata  
 Kagoshima University, Japan
- 16G3-4 Reduction of Common Mode Disturbances in Parallel Modules of Integrated Modular Motor Drives**  
 Philipp Marx, Jan Assenheimer, Philipp Ziegler, Jörg Haarer, Jörg Roth-Stielow  
 University of Stuttgart, Germany

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## Room H

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### Session 16H3 Motor design & control

**Chairs:** Yu Hasegawa (*Hitachi Ltd., Japan*)  
 Wolfgang Gruber (*Johannes Kepler University Linz, Austria*)

- 16H3-1 Multiobjective Particle Swarm Optimization Design of Permanent Magnet Machine for Torque Density Improvement and Torque Ripple Suppression**  
 Jiaxuan Huang<sup>1</sup>, Yi Sui<sup>1</sup>, Zuosheng Yin<sup>1</sup>, Guopeng Liu<sup>1</sup>, Ping Zheng<sup>1</sup>, Yongjian Li<sup>2</sup>  
 1) Harbin Institute of Technology, China, 2) Hebei University of Technology, China
- 16H3-2 Anti-Demagnetization Design of IPMSM Using an Automatic Design System Combining Coarse-Mesh FEM and GA**  
 Yutaro Mambo<sup>1</sup>, Masayuki Sanada<sup>2</sup>, Shigeo Morimoto<sup>2</sup>, Yukinori Inoue<sup>2</sup>  
 1) Osaka Prefecture University, Japan, 2) Osaka Metropolitan University, Japan
- 16H3-3 Fitting Method of Experimentally Measured 3D Loss and Torque Maps to design Optimal Trajectories for IPMSM**  
 Kaoru Inoue, Yusuke Naito, Toshiji Kato  
 Doshisha University, Japan
- 16H3-4 Stable Equilibrium Rotor Positions for a Three-Phase Switched Reluctance Machine**  
 Georg Tobias Götz, Philipp Tillmann, Anne von Hoegen, Rik W. De Doncker  
 RWTH Aachen University, Germany

Room A

**Session 17A1 Emerging Technology for Cutting Edge Wide Band Gap Semiconductor Device (OS)**

**Chairs:** Tsuyoshi Funaki (*Osaka University, Japan*)  
Yan Zhang (*Xi'an Jiaotong University, China*)

**17A1-1 Development of  $\alpha$ -Ga<sub>2</sub>O<sub>3</sub> Power Devices**

*Invited Paper* Takashi Shinohe  
*FLOSFIA INC., Japan*

**17A1-2 Gallium Oxide Power Device Technologies**

*Invited Paper* Masataka Higashiwaki  
*National Institute of Information and Communications Technology, Japan*

**17A1-3 GaN-based Solutions for Cost-effective Direct and Indirect Time-of-Flight Lidar Transmitters Are Changing the Way We Live**

*Invited Paper* Alex Lidow, John Glaser  
*Efficient Power Conversion Corporation, USA*

**17A1-4 R&D Bridging over Device and System Engineers Through the Electric-Mileage Estimation of a Motor System**

*Invited Paper* Ken Nakahara, Hirokatsu Umegami, Toshikazu Harada, Takukazu Otsuka, Atsushi Yamaguchi  
*ROHM Co., Ltd., Japan*

**17A1-5 Reliability and robustness of SiC power devices –how to ensure the quality level established in the silicon world**

*Invited Paper* Peter Friedrichs  
*Infineon, Germany*

Room B

**Session 17B1 Motor Drive Technologies for Industrial Applications (OS)**

**Chairs:** Shizunori Hamada (*Meidensha Corporation, Japan*)  
Ikuya Sato, (*Fuji Electric Co., Ltd., Japan*)

**17B1-1 Improved Power Density of Large-capacity Drives for Steel Plants**

*Invited Paper* Katsuhiko Fukuma, Haruyuki Yamaguchi, Ufot Ufot Ekong, Masahiko Tsukakoshi  
1) *Toshiba-Mitsubishi-Electric Industrial Systems Corporation, Japan*

**17B1-2 High-Precision Torque Control of IPMSM Considering Magnetic Saturation and Magnet Temperature Variation**

*Invited Paper* Yoshiyasu Takase, Yasumasa Hamabe, Hengbin Rui, Shinya Morimoto, Koji Higashikawa  
*YASKAWA ELECTRIC CORPORATION, Japan*

**17B1-3 Electrolytic Capacitor-less Inverter Technology for Miniaturization of Air Conditioning System**

*Invited Paper* Tatsuki Inoue, Hiroataka Doi, Takayuki Miyajima  
*Daikin Industries, LTD., Japan*

**17B1-4 Improvement of system efficiency by variable switching frequency control for converter**

*Invited Paper* Koji Tsukii<sup>1</sup>, Masahiro Tamura<sup>1</sup>, Wataru Hatsuse<sup>2</sup>, Yasuo Notohara<sup>2</sup>  
1) *Johnson Controls-Hitachi Air Conditioning, Inc., Japan*, 2) *Hitachi Ltd., Japan*

**17B1-5 Torque Enhancement of Surface Permanent Magnet Motors utilizing Reluctance Torque for High-speed Motors with Bonded Magnets**

*Invited Paper* Koji Yamaguchi, Tomoya Yamamoto, Naoki Omura, Takehiro Jikumaru  
*IHI Corporation, Japan*

## **Session 17C1 Advanced Power Conversion and Control for Railways (OS)**

**Chairs:** Takafumi Koseki (*The University of Tokyo, Japan*)

Hiroyasu Kobayashi (*Chiba University, Japan*)

- 17C1-1 Position Sensorless Control of Synchronous Reluctance Machines based on Fundamental Saliency Method for Railway Traction**  
*Invited Paper*  
Tetsuya Kojima<sup>1</sup>, Toshiki Suzuki<sup>1</sup>, Kota Teramoto<sup>1</sup>, Tetsuo Sugahara<sup>1</sup>, Tatsuro Takahashi<sup>2</sup>, Takuya Saito<sup>2</sup>  
1) Mitsubishi Electric Corporation, Japan, 2) Tokyo Metro Co., Ltd., Japan
- 17C1-2 Wheel Slip Control Technologies on Japanese Railways**  
*Invited Paper*  
Shingo Makishima<sup>1</sup>, Keiichiro Kondo<sup>2</sup>, Hiroki Shimoyama<sup>3</sup>, Daiki Sato<sup>4</sup>, Satoru Takahashi<sup>1</sup>, Takafumi Koseki<sup>5</sup>  
1) Toyo Denki Seizo K. K., Japan, 2) Waseda University, Japan, 3) Central Japan Railway Company, Japan, 4) Tokyo Denki University, Japan, 5) The University of Tokyo, Japan
- 17C1-3 Integration of Onboard Batteries and Supercapacitors Based on the Multi-Source Inverter for Light Rail Vehicles**  
*Invited Paper*  
Emanuele Fedele, Antonio Di Pasquale, Diego Iannuzzi, Mario Pagano  
*Universita di Napoli "Federico II", Italy*
- 17C1-4 Study on Interconnecting Operation Control of Electronic Frequency Converters Realizing the Replacement of All Rotary Frequency Changers in Nishisagami Substation in the Tokaido Shinkansen**  
*Invited Paper*  
Toshimasa Shimizu<sup>1</sup>, Ken Kunomura<sup>1</sup>, Hiroki Miyajima<sup>2</sup>, Takumi Nagai<sup>2</sup>  
1) Central Japan Railway Company, Japan, 2) Toshiba Infrastructure Systems & Solutions Corporation, Japan
- 17C1-5 Outstanding Technical Features of Traction System in N700S Shinkansen New Generation Standardized High Speed Train**  
*Invited Paper*  
Kenji Sato, Hirokazu Kato, Takafumi Fukushima  
*Central Japan Railway Company, Japan*

## **Session 17D1 Industrial Instrumentation and Control II**

**Chairs:** Seiichiro Katsura (*Keio University, Japan*)

Rae-Young Kim (*Hanyang University, Korea*)

- 17D1-1 Data-Driven Analysis of Distributed Generator-Based Power Systems Using Koopman Mode Decomposition**  
Yuko Hirase, Yuki Ohara, Takeaki Yamazaki  
*Toyo University, Japan*
- 17D1-2 Model Predictive Control with Reduced Computation for N-cell Cascaded Flying Capacitor H-Bridge Converter in Solid-State Transformer**  
Dong-Hwan Park, Rae-young Kim  
*Hanyang University, Korea*
- 17D1-3 An Improved Finite Control Set Model Predictive Control for LC-filter VSI against Model LC Mismatch**  
Van-Tien Le<sup>1</sup>, Huu-Cong Vu<sup>2</sup>, Hong-Hee Lee<sup>1</sup>  
1) University of Ulsan, Korea, 2) Hanoi University of Civil Engineering, Viet Nam
- 17D1-4 An Optimized Intelligent Technique for Bearing Fault Diagnosis using Motor Current Signal Analysis**  
Jiang Xinjie<sup>1</sup>, Hasmat Malik<sup>2</sup>, Sanjib Kumar Panda<sup>1</sup>  
1) National University of Singapore, Singapore, 2) Berkeley Education Alliance for Research in Singapore (a research center of the University of California, USA), Singapore
- 17D1-5 Vibration Suppression Using Vibration Coordinate System Based on dq Transform with Specific Frequency**  
Tatsuya Kani, Masato Koyama  
*Mie University, Japan*

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## Room E

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### Session 17E1 Latest solution for EMI and EMC

Chairs: Tomoyuki Mannen (*Univseity of Tsukuba, Japan*)

Changsheng Hu (*Zhejiang University, China*)

- 17E1-1 **Evaluation of Factors Impacting Reflected Wave Phenomenon in WBG Based Motor Drives**  
Kushan Choksi, Yuxuan Wu, Mustafeez-ul-Hassan, Fang Luo  
*Stony Brook University, USA*
- 17E1-2 **Overmodulation Technique on Common Mode Voltage Reduction PWM Inverter using Saw-Wave Carrier Signal**  
Tatsuki Kashihara, Yushi Araki, Hiroshi Yoshida, Koji Kobayashi  
*SANDEN CORPORATION, Japan*
- 17E1-3 **Common Mode Noise Reduction of Two-Phase Interleaved Boost Converters with Integrated Magnetics Utilizing Balanced Technique**  
Tomotaka Nagai<sup>1</sup>, Mamoru Sasaki<sup>1</sup>, Jun Imaoka<sup>1</sup>, Masayoshi Yamamoto<sup>1</sup>, Akira Nakano<sup>2</sup>  
1) *Nagoya University, Japan*, 2) *ALPS ALPINE CO., LTD., Japan*
- 17E1-4 **An Investigation on the Relationship between CM Noise and Distribution of Parasitic Capacitance**  
Mamoru Sasaki, Jun Imaoka, Masayoshi Yamamoto  
*Nagoya University, Japan*

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## Room F

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### Session 17F1 Latest Applications of Power Converters from Industry

Chairs: Hirohito Funato (*Utsunomiya University, Japan*)

Yushi Koyama (*Toshiba Infrastructure Systems & Solutions Corporation, Japan*)

- 17F1-1 **Inter-cluster balancing of Solid-State Transformer Based on a Feedforward Negative-Sequence Power Control**  
Tsuyoshi Nagano, Koroku Nishizawa, Laxman Maharjan, Toshihisa Tajyuta, Koji Maruyama  
*Fuji Electric Co., Ltd., Tokyo, Japan*
- 17F1-2 **Design and Installation of STATCOM System for Wind and Photovoltaic Power Plant**  
Takayuki Yachida, Ryota Okuyama, Naoki Morishima, Yusuke Ashizaki, Yohei Itaya  
*Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan*
- 17F1-3 **Development of 500kW Class PCS for Hydrogen-powered Fuel Cell Applications**  
Haiqing Li, Kohki Morisaki  
*Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan*
- 17F1-4 **Proposal and Evaluation of High-Heat Insulation System for Spacecraft by Using WPT**  
Sayuri Honda<sup>1</sup>, Shuhei Shimada<sup>1</sup>, Kosuke Tanaka<sup>1</sup>, Kana Nakamura<sup>2</sup>, Takehiro Imura<sup>3</sup>,  
Katsuhiro Hata<sup>4</sup> and Yoichi Hori<sup>3</sup>  
1) *Japan Aerospace Exploration Agency, Japan*, 2) *University of Tsukuba, Japan*, 3) *Tokyo University of Science, Japan*, 4) *The University of Tokyo, Japan*

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## Room G

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### Session 17G1 Induction Motor Drives

Chairs: Hisao Kubota (*Meiji University, Japan*)

Kazuhiro Ohyama (*Fukukoka Institute of Technology, Japan*)

- 17G1-1 **Current Vector Control System Based on a New Discrete dq-Axis IM Model for High Speed Drive**  
Takuma Takeuchi<sup>1</sup>, Shinji Doki<sup>1</sup>  
*Nagoya University, Japan*
- 17G1-2 **FEA-Assisted Experimental Parameter Identification of Induction Motor**  
Jiwon Yoo<sup>1</sup>, Joon-Hee Lee<sup>2</sup>, Seung-Ki Sul<sup>1</sup>  
1) *Seoul National University, Korea*, 2) *LG Electronics, Korea*
- 17G1-3 **Current Optimization for Low-Frequency Ride-Through in Speed-Sensorless Induction Motor Drives**  
Cheng Luo, Ruhan Li, Kai Yang, Bo Wang, Yong Yu, Dianguo Xu  
*Huazhong University of Science and Technology, China*

**17G1-4 Improvement of Start-Up Performance at the Standstill Condition of Induction Motor Speed Sensorless Vector Control Using Adaptive Flux Observer**

Erina Izumi<sup>1</sup>, Masaki Nagataki<sup>1</sup>, Keiichiro Kondo<sup>1</sup>, Shunsuke Tobayashi<sup>2</sup>, Hiromitsu Suzuki<sup>2</sup>

1) Waseda University, Japan, 2) Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan

**17G1-5 A Method for Determining Equivalent Circuit Constant of Linear Induction Motors Using Locked Mover and Standstill Impedance Tests**

Hideaki Hirahara, Mikito Inoue, Shu Yamamoto

Polytechnic University, Tokyo, Japan

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**Room H**

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**Session 17H1 Reluctance machines**

**Chairs:** Kyohei Kiyota (*Tokyo Institute of Technology, Japan*)

Fuat Kucuk (*Kyoto University of Advanced Science, Japan*)

**17H1-1 Efficiency Improvement of Switched Reluctance Motor with three-dimensional Gap Structure**

Jie Zhang, Kazuhiro Ohyama

Fukuoka Institute of Technology, Japan

**17H1-2 An Innovative Mutually Coupled Switched Reluctance Motor for Torque Enhancement and Torque Ripple Mitigation**

Dongshan Fu<sup>1</sup>, Hongyu Si<sup>1</sup>, Ping Zheng<sup>2</sup>, Yue Liu<sup>1</sup>, Xiaojie Wu<sup>1</sup>, Yanliang Xu<sup>3</sup>, Weilin Zong<sup>1</sup>

1) China University of Mining and Technology, China, 2) Harbin Institute of Technology, China, 3) Shandong University, China

**17H1-3 Transverse-Flux-type Switched Reluctance Motor with Permanent Magnets applying Reverse Bias Magnetic Field**

Ayumi Nagai, Kazuhide Mitsuya, Kanji Nakamura

Tohoku University, Japan

**17H1-4 Modeling of a Modular Stator Segmented Rotor Switched Reluctance Motor for Circuit Simulation**

Belle S. Sermeno, Ramon Florentino L. Santos, Lew Andrew R. Tria

University of the Philippines Diliman, Philippines

**17H1-5 Examination of non-sinusoidal drive in Direct Current excited Reluctance motor**

Akito Yamaguchi, Yudai Koishi, Hiroki Goto

Utsunomiya University, Japan

**Tuesday, May 17: 11:35-13:15**

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**Room A**

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**Session 17A2 Reliability Improvement in Power Electronics Systems (OS)**

**Chairs:** Kyo-Beum Lee (*Ajou University, Korea*)

Hitoshi Haga (*Nagaoka University of Technology, Japan*)

**17A2-1 Zero-Sequence Current Control for Open-End Winding IPMSM Fed by Dual Inverter with a Common Source**

*Invited Paper* Sung-Jin Jang, Jun-Ho Hwang, Hyung-Woo Lee, Kyo-Beum Lee

Ajou University, Korea

**17A2-2 Analysis and Suppression of Zero-Sequence Circulating Current in Parallel Three-Level Inverters using Improved Interleaved DPWM**

*Invited Paper*

Jun-Hyeok Park, Hye-Won Choi, Kyo-Beum Lee

Ajou University, Korea

**17A2-3 Fault Diagnosis and Tolerance for Open-circuit Faults in Multi-Level Inverters**

*Invited Paper* Laith M. Halabi, Ibrahim Mohd Alsofyani, Kyo-Beum Lee

Ajou University, Korea

- 17A2-4 Modified Predictive Torque Control for Balancing Three-Level NPC Inverter-fed Permanent Magnet Synchronous Motor**  
*Invited Paper*  
Samer Saleh Hakami, Kyo-Beum Lee  
Ajou University, Korea

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**Room B**

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**Session 17B2 Multi-level converters I**

**Chairs:** Makoto Hagiwara (*Tokyo Institute of Technology, Japan*)  
Jiacheng Wang (*Simon Fraser University, Canada*)

- 17B2-1 A Five-Level Unity-Gain Active Neutral-Point-Clamped Inverter Designed Using Half-Bridges**  
Sze Sing Lee<sup>1</sup>, Yam P. Siwakoti<sup>2</sup>, Reza Barzegarkhoo<sup>2</sup>, Kyo-Beum Lee<sup>3</sup>  
1) Newcastle University in Singapore, Singapore, 2) University of Technology Sydney, Australia, 3) Ajou University, Korea
- 17B2-2 An Interleaved Switched-Boost Common-Ground Five-Level Inverter**  
Majid Farhangi<sup>1</sup>, Reza Brazegarkhoo<sup>1</sup>, Sze Sing Lee<sup>2</sup>, Dylan Lu<sup>1</sup>, Yam Siwakoti<sup>1</sup>  
1) University of Technology Sydney, Australia, 2) Newcastle University in Singapore, Singapore
- 17B2-3 A Novel Seven-Level Switched-Boost Common-Ground Inverter With Single-Stage Dynamic Voltage Boosting Gain**  
Reza Barzegarkhoo<sup>1</sup>, Majid Farhangi<sup>1</sup>, Sze Sing Lee<sup>2</sup>, Ricardo P. Aguilera<sup>1</sup>, Yam P. Siwakoti<sup>1</sup>  
1) University of Technology Sydney, Australia, 2) Newcastle University in Singapore, Singapore
- 17B2-4 Operating Scheme of Six-Level Hybrid Inverters with Reduced Capacitor Count**  
Jonathan Pribadi, Dong-Choon Lee  
Yeungnam University, Korea

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**Room C**

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**Session 17C2 DC-DC Converter for Industrial Applications**

**Chairs:** Kazunobu Oi (*Meidensha Corporation, Japan*)  
Weimin Wu (*Shanghai Maritime University, China*)

- 17C2-1 Decoupling Analysis and Modeling for Threeport Resonant Converter**  
Yuqi Wei<sup>1,2</sup>, Thiago Pereira<sup>2</sup>, Marco Liserre<sup>2</sup>, H. Alan Mantooth<sup>1</sup>  
1) University of Arkansas, USA, 2) Kiel University, Germany
- 17C2-2 Two-stage Battery Energy Storage Power Conversion System Based on Dual Active Bridge**  
Liangyi Wang, Ning Gao, Weimin Wu  
Shanghai Maritime University, China
- 17C2-3 Voltage Balancing Control of Bidirectional Input-Series Output-Series Dual Active Bridge DC/DC Converters without Auxiliary Circuits**  
Kazunobu Oi<sup>1,2</sup>, Hayato Higa<sup>1</sup>, Kazunori Morita<sup>1</sup>, Shota Urushibata<sup>1</sup>, Yugo Tadano<sup>1</sup>, Yukihiro Sato<sup>2</sup>  
1) MEIDENSHA CORPORATION, Japan, 2) Chiba University, Japan
- 17C2-4 Vibration Power Generation System using a Piezoelectric Element With a Variable Resistance Control for Optimal Generated Power**  
Naotaka Nakahigashi, Hiroaki Yamada  
Yamaguchi University, Japan

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**Room D**

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**Session 17D2 Human and Machine Control System**

**Chairs:** Kaoru Mitsuhashi (*Polytechnic University, Japan*)  
Hirooki Aoki (*Chitose Institute of Science and Technology, Japan*)

- 17D2-1 On selection of topics that users are interested in but are not familiar with**  
Yuya Sakai, Mitsuharu Matsumoto  
University of Electro-Communications, Japan

**17D2-2 A Scheme for Spatial Resolution Improvement of Thermal Images for Objects with Different Emissivity**

Kazuyuki Hidaka, Katsuya Kondo, Shunya Sato  
*Tottori University, Japan*

**17D2-3 Automatic Data Extraction based on Semiconductor Datasheet for Design Automation of Power Converters**

Fanghao Tian, Diego Bernal Cobaleda, Wilmar Martinez  
*KU Leuven-Energyville, Belgium*

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**Room E**

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**Session 17E2 Control and Analysis of Inverters**

**Chairs:** Shin-ichi Hamasaki (*Nagasaki University, Japan*)

Jung-Ik Ha (*Seoul National University, Korea*)

**17E2-1 Influence of Dead-Time and Diode's Reverse Recovery on the Input Current Ripple of Three-phase Voltage Source Inverters**

Juris Arrozy, Darian V. Retianza, Henk Huisman, Jorge L. Duarte  
*Eindhoven University of Technology, The Netherlands*

**17E2-2 Common Mode Voltage Reduction and Neutral-Point Voltage Balance for Quasi-Z-Source Three-Level Neutral-Point-Clamped Inverters**

Wenjie Liu<sup>1</sup>, Yongheng Yang<sup>2</sup>, Weilin Li<sup>1</sup>, Xiaobin Zhang<sup>1</sup>, Oleksandr Husev<sup>3</sup>, Dmitri Vinnikov<sup>3</sup>  
1) *Northwestern Polytechnical University, China*, 2) *Zhejiang University, China*, 3) *Tallinn University of Technology, Estonia*

**17E2-3 Double-Carrier-Based PWM Theory for Independent Power Control of Dual-Input Three-level Inverters**

Monchai Ariyapuek<sup>1</sup>, Surapong Suwankawin<sup>1</sup>, Somboon Sangwongwanich<sup>1</sup>, Ariya Sangwongwanich<sup>2</sup>  
1) *Chulalongkorn University, Thailand*, 2) *Aalborg University, Denmark*

**17E2-4 Voltage Modulation Method for T-type Three-Level Inverter with Reduced Conduction Loss in Low Voltage Modulation Region**

Cheolmin Hwang, Gyu Cheol Lim, Jonghun Choi, Jung-Ik Ha  
*Seoul National University, Korea*

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**Room F**

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**Session 17F2 Wireless Power Transfer II**

**Chairs:** Keisuke Kusaka (*Nagaoka University of Technology, Japan*)

Yun Yang (*The University of Hong Kong, China*)

**17F2-1 A General Primary-side Coupling Coefficient and Load Monitoring Method for Inductive Power Transfer Systems**

Kaiyuan Wang, Yun Yang  
*The Hong Kong Polytechnic University, China*

**17F2-2 Analysis of Scaling Characteristics for Inductive Power Transfer Coils**

Giuseppe Guidi<sup>1</sup>, Jon Are Suul<sup>1,2</sup>  
1) *SINTEF Energy Research, Norway*, 2) *Norwegian University of Science and Technology, Norway*

**17F2-3 Four-switch Class-PN Power Amplifier for High Power Handling Capability in Wireless Power Transfer**

Faheem Ahmad, Asger Bjorn Jorgensen, Stig Munk-Nielsen  
*Aalborg University, Denmark*

**17F2-4 A Primary-Side Gain-Scheduled Controller Based on Dynamic Coupling Estimation for Inductive Battery Charging Systems with Sub-resonant Frequency Control**

Jiayu Zhou<sup>1</sup>, Giuseppe Guidi<sup>2</sup>, Shuxin Chen<sup>3</sup>, Yi Tang<sup>3</sup>, Jon Are Suul<sup>1,2</sup>  
1) *Norwegian University of Science and Technology, Norway*, 2) *SINTEF Energy Research, Norway*, 3) *Nanyang Technological University, Singapore*

### **Session 17G2 Grid Forming Converters III**

**Chairs:** Yoshinobu Ueda (*Meidensha Corporation, Japan*)  
Yongsug Suh (*Jeonbuk National University, Korea*)

- 17G2-1 A Control Method of Reduced Reactive Power Ripple in Grid-connected Converters under Unbalanced Grid Conditions**  
Jaehoon Choi, Yongsug suh  
*Jeonbuk National University, Koera*
- 17G2-2 Global Impedance Identification of Inverter-Based Power Systems Using Grid-Forming-Inverter-Based Current Perturbation Injections at Single Node**  
Weihua Zhou, Nabil Mohammedy, Behrooz Bahrniz  
*Monash University, Australia*
- 17G2-3 Artificial Neural Network-based Intelligent Grid Impedance Identification Method for Grid-Connected Inverter**  
Yuan Qiu, Yanbo Wang, Yanjun Tian, Zhe Chen  
*Aalborg University, Denmark*
- 17G2-4 Augmentation of Generalized Multivariable Grid-Forming Control for Power Converters with Cascaded Controllers**  
Meng Chen<sup>1</sup>, Dao Zhou<sup>1</sup>, Ali Tayyebi<sup>2</sup>, Eduardo Prieto-Araujo<sup>3</sup>, Florian Dörfler<sup>2</sup>, Frede Blaabjerg<sup>1</sup>  
1) *Aalborg University, Denmark*, 2) *Swiss Federal Institute of Technology (ETH) Zurich, Switzerland*, 3) *CITCEA-UPC, Technical University of Catalonia, Spain*

### **Session 17H2 PM machines I**

**Chairs:** Katsutoku Takeuchi (*Toshiba Infrastructure Systems & Solutions, Japan*)  
Kyohei Kiyota (*Tokyo Institute of Technology, Japan*)

- 17H2-1 Rotor Structure for Suppressing Irreversible Demagnetization of Magnets in Double-layered Interior Permanent Magnet Synchronous Motors**  
Atsushi Nakata<sup>1</sup>, Masayuki Sanada<sup>2</sup>, Shigeo Morimoto<sup>2</sup>, Yukinori Inoue<sup>2</sup>  
1) *Osaka Prefecture University, Japan*, 2) *Osaka Metropolitan University, Japan*
- 17H2-2 Reduction of Magnetization Current in a Variable-Magnetization IPM Motor with Two Ushaped Arrangement for Electric Vehicles**  
Wataru Suzuki, Kazuto Sakai  
*Toyo University, Japan*
- 17H2-3 Prototype Tests of Segment-type Outer-Rotor PM motor**  
Sho Sakurai, Yutaro Uchiyama, Kenji Nakamura  
*Tohoku University, Japan*
- 17H2-4 Prototype Test Results of Inset-type Permanent Magnet Machine made of NANOMET® Laminated Core**  
Yue Yu<sup>1</sup>, Shozo Hiramoto<sup>2</sup>, Kenji Nakamura<sup>1</sup>  
1) *Tohoku University, Japan*, 2) *Tohoku Magnet Institute Co., Ltd., Japan*

Room A

**Session 17A3 High performance Isolated DC-DC Converters in Emerging Applications (OS)**

**Chairs:** Kai Sun (*Tsinghua University, China*)  
Jung-Ik Ha (*Seoul National University, Korea*)

**17A3-1 A Modulation Method of Series-Resonant Dual-Active Half-Bridge Converter for ZVS and Minimum RMS current**  
*Invited Paper*

Jin-Su Hong, Sunghyuk Choi, Jung-Ik Ha  
*Seoul National University, Korea*

**17A3-2 Optimal Design of a Constant Frequency Series-Resonant DC/DC converter with Wide Voltage Gain Range for Single-Stage Isolated AC/DC Power Conversion**  
*Invited Paper*

Jie Liu<sup>1</sup>, Yujie Cheng<sup>2</sup>, Yihang Jia<sup>1</sup>, Hongfei Wu<sup>1</sup>  
1) *Nanjing University of Aeronautics and Astronautics, China*, 2) *Nanjing Electronic Devices Institute, China*

**17A3-3 Analysis of Partial Parallel Dual Active Bridge Converter with Additional Phase Shift Control**  
*Invited Paper*

Jiasheng Huang, Chang Wang, Zhe Zhang, Ziwei Ouyang, Gabriel Zsurzsan, Michael A.E. Andersen  
*Technical University of Denmark, Denmark*

**17A3-4 Efficiency Improvement of Current-Fed DAB Converter by Triangular Current Mode for Wide Voltage Applications**  
*Invited Paper*

Hiroki Watanabe, Akira Tamagawa, Jun-ichi Itoh  
*Nagaoka University of Technology, Japan*

**17A3-5 An Inner Phase Shift Control Scheme for the CLLC Converter**  
*Invited Paper*

Huan Chen, Kai Sun, Haixu Shi, Leheng Wang, Kai Zhang  
*Tsinghua University, China*

Room B

**Session 17B3 EMI Mitigation for Power Electronics Converters (OS)**

**Chairs:** Dong Jiang (*Huazhong University of Science and Technology, China*)  
Shuo Wang (*University of Florida, USA*)

**17B3-1 EMI Analysis of Three-Phase Three-Level Flying Capacitors Diode Clamped DAB Converter**  
*Invited Paper*

Yuxuan Chen, Wenjie Chen, Jinlu Liu, Daoxin Tong, Xin Ma  
*Xi'an Jiaotong University, China*

**17B3-2 Common-Mode Voltage Mitigation for Three-Phase Hybrid NPC Inverter with Flying-Capacitor Leg**  
*Invited Paper*

Xuan Zhao, Dong Jiang, Wei Sun, Jialou Gao  
*Huazhong University of Science and Technology, China*

**17B3-3 Conducted EMI Reduction of Modular Multilevel Converter Based on Chaotic Nearest Level Modulation**  
*Invited Paper*

Zuoxing Wang<sup>1</sup>, Hong Li<sup>1</sup>, Zhaoyi Chu<sup>1</sup>, Chongmo Zhang<sup>1</sup>, Zhichang Yang<sup>2</sup>, Tiancong Shao<sup>1</sup>  
1) *Beijing Jiaotong University, China*, 2) *Global Energy Interconnection Research Institute Co., Ltd., China*

**17B3-4 Characterization and Design of Filter Inductors and Capacitors to Suppress the Radiated EMI in A Power Converter**  
*Invited Paper*

Yingjie Zhang, Shuo Wang  
*University of Florida, USA*

**17B3-5 A Low-cost Active Reflected Wave Canceller for MMC Motor Drive using SiC Devices**  
*Invited Paper*

Yu Zhang, Zhehui Guo, Hui Li, Fangzheng Peng  
*Florida State University, USA*

### **Session 17C3 Energy Storage System for Railway Systems (OS)**

**Chairs:** Shingo Makishima (*Toyo Denki Seizo K. K., Japan*)

Takafumi Koseki (*The University of Tokyo, Japan*)

**17C3-1 Case study of four battery-powered methods to run electric trains on non-electrified lines**

*Invited Paper* Masamichi Ogasawara  
*Railway Technical Research Institute, Japan*

**17C3-2 Contribution of Wayside Energy Storage Systems to Short Circuit Currents in DC Railway Traction Power Systems**

*Invited Paper* Antonio Di Pasquale, Emanuele Fedele, Diego Iannuzzi, Mario Pagano  
*Università degli studi di Napoli Federico II, Italy*

**17C3-3 Overview of Power Electronics Applications for Fixed Installations of Urban Railway Power Supply for Regenerative Energy Utilization**

*Invited Paper* Takashi Suzuki<sup>1</sup>, Daisuke Kumagai<sup>1</sup>, Ryo Takahashi<sup>1</sup>, Yuuki Mizumoto<sup>1</sup>, Hidenori Sato<sup>1</sup>, Yuuki Iino<sup>1</sup>, Shirou Sekijima<sup>2</sup>, Masashi Nakahira<sup>1</sup>, Hitoshi Hayashiya<sup>1</sup>  
1) *East Japan Railway Company, Japan*, 2) *Nippon Rietec Co., Ltd., Japan*

**17C3-4 Traction Energy Storage Systems applied with SCiB™**

*Invited Paper* Nobuhiko Satake<sup>1</sup>, Masayuki Nogi<sup>1</sup>, Koji Maki<sup>1</sup>, Motokatsu Ogi<sup>1</sup>, Manato Mori<sup>1</sup>, Geronimo Anthony Ivan Capitin<sup>1</sup>, Akira Tanaka<sup>2</sup>  
1) *Toshiba Infrastructure Systems & Solutions Corporation, Japan*, 2) *Toshiba IT & Control Systems Corporation, Japan*

**17C3-5 Method to Design Control System of Traction Inverter of DC-electrified Railway Vehicle for an Increase in Regenerative Brake Power**

*Invited Paper* Hiroyasu Kobayashi<sup>1</sup>, Natsuki Kawagoe<sup>1</sup>, Keiichiro Kondo<sup>1</sup>, Tetsuya Iwasaki<sup>2</sup>, Akihiro Tsumura<sup>2</sup>  
1) *Waseda University, Japan*, 2) *Odakyu Electric Railway Co., Ltd., Japan*

### **Session 17D3 Human Factor and Image Intelligent System (OS)**

**Chairs:** Kaoru Mitsunashi (*Polytechnic University, Japan*)

Takio Kurita (*Hiroshima University, Japan*)

**17D3-1 Summary of Works on Image Classification with Noisy Labels**

*Invited Paper* Yuichiro Nomura, Takio Kurita  
*Hiroshima University, Japan*

**17D3-2 Pixel Relationships-based Regularizer for Retinal Vessel Image Segmentation**

*Invited Paper* Lukman Hakim, Takio Kurita  
*Hiroshima University, Japan*

**17D3-3 Investigation of Training Effects and Services by Skill Motion Training Games**

*Invited Paper* Akira Tao<sup>1</sup>, Osamu Ichikawa<sup>1</sup>, Kaoru Mitsunashi<sup>2</sup>  
1) *Polytechnic University of Japan, Japan*, 2) *Teikyo University, Japan*

**17D3-4 Suggestion of AR Presentation Tool for PC Operating Handicapped Users**

*Invited Paper* Kaoru Mitsunashi<sup>1</sup>, Tomoaki Maruyama<sup>2</sup>, Hiroshi Takeshita<sup>3</sup>  
1) *Teikyo University, Japan*, 2) *National Institute of Technology (KOSEN), Japan*, 3) *Tsukuba University of Technology, Japan*

**17D3-5 Interactive Media Art by Applying Depth Sensing**

*Invited Paper* Hirooki Aoki  
*Chitose Institute of Science and Technology, Japan*

### **Session 17E3 Parasitics Analysis and Design**

**Chairs:** *Shuhei Fukunaga (Osaka University, Japan)*

*Liu Jia (Xi'an Jiaotong University, China)*

- 17E3-1 Analysis and Design of a High Power Density Full-Ceramic 900V DC-Link Capacitor for a 550 kVA Electric Vehicle Drive Inverter**  
Davide Cittanti<sup>1</sup>, Fausto Stella<sup>1</sup>, Enrico Vico<sup>1</sup>, Chaohui Liu<sup>2</sup>, Jinliang Shen<sup>2</sup>, Guidong Xiu<sup>2</sup>, Radu Bojoi<sup>1</sup>  
*1) Politecnico di Torino, Italy, 2) National New Energy Vehicle Technology Innovation Center, China*
- 17E3-2 Robust HV Power pLDMOS Components for ESD Protection by the Drain-side Parasitic Schottky Diode and SCR Engineering**  
Shen-Li Chen<sup>1</sup>, Shi-Zhe Hong<sup>1</sup>, Wei-Jung Chen<sup>2</sup>  
*1) National United University, Taiwan, 2) National Yang Ming Chiao Tung University, Taiwan*
- 17E3-3 Design the Phase Output Bar for Improving Static Current Sharing Among Parallel IGBTs in High Power Stack Application**  
Zheng-Feng Li<sup>1</sup>, Nobuya Nishida<sup>2</sup>, Hiroto Aoki<sup>3</sup>, Hisashi Shibata<sup>3</sup>, Chih-Hung Ma<sup>1</sup>, Hsiang-Ming Liu<sup>1</sup>, Ming-Shi Huang<sup>1</sup>  
*1) National Taipei University of Technology, Taiwan, 2) Mitsubishi Electric Corporation, Japan, 3) TAMURA Corp., Japan*
- 17E3-4 Passive components facing wideband gap devices' new thermal and electrical challenges**  
Thomas Fouet<sup>1</sup>, Simon Dario<sup>1</sup>, Tomokazu Sakuraba<sup>2</sup>, Herwig Süncksen<sup>3</sup>, Jean-François de Palma<sup>1</sup>  
*1) Mersen, France, 2) Mersen, Japan, 3) Mersen, Germany*
- 17E3-5 Analysis of Clearance Effect for Perforated Terminals Isolation of a Laminated Busbar to Parasitic Parameters**  
Koji Mitsui, Keiji Wada  
*Tokyo Metropolitan University, Japan*

### **Session 17F3 Power Supplies**

**Chairs:** *Shohei Komeda (Tokyo University of Marine Science and Technology, Japan)*

*Yu-Chen Liu (National Ilan University, Taiwan)*

- 17F3-1 Analysis of Winding Coverage in Planar Transformers with Fractional Turns for High Frequency LLC Resonant Converters**  
Yu-Chen Liu, Meng-Chi-Tsai, Phuc-Dinh Nguyen  
*National Ilan University, Taiwan*
- 17F3-2 A Variable Switching Frequency Control Method for a Dual-Active-Bridge Single-Phase AC-DC Converter with an Active Energy Buffer**  
Shohei Komeda<sup>1</sup>, Shunsuke Takuma<sup>2</sup>, Yoshiya Ohnuma<sup>2</sup>  
*1) Tokyo University of Marine Science and Technology, Japan, 2) Nagaoka Power Electronics Co., Ltd., Japan*
- 17F3-3 A Butterfly Interleaving Multiphase Coupled Inductor Buck Converter for Datacenters with 99.3% Peak Efficiency**  
Mingxiao Li<sup>1,2</sup>, Yunfeng Liu<sup>1</sup>, Ziwei Ouyang<sup>1</sup>, Michael A. E. Andersen<sup>1</sup>, Teng Long<sup>2</sup>  
*1) Technical University of Denmark, Denmark, 2) University of Cambridge, UK*
- 17F3-4 High-Efficiency Asymmetrical Half-Bridge Converter with Series Capacitor Rectifier and Linear Voltage Gain**  
Juhyun Bae, Jae-Sang Kim, Minsu Lee, Jeongchan Park, Gun-Woo Moon  
*Korea Advanced Institute of Science and Technology (KAIST), Korea*
- 17F3-5 Proposal of Virtual Transformer-Based Back-To-Back Asynchronous Loss Measurement Using a Single Set of Measurement Instruments for One Inverter and Experimental Verification**  
Atsuo Kawamura, Yoshiki Nasu, Yasuhiko Miguchi, Hadi Setiadi, Hidemine Obara  
*Yokohama National University, Japan*

### **Session 17G3 Wind Power Generator and Related Control**

**Chairs:** Ryosuke Saito (*Toshiba Infrastructure Systems & Solutions Corporation, Japan*)  
Dongsheng Li (*Hitachi Ltd., Japan*)

- 17G3-1 Research on Control for Grid-connected Brushless Doubly-Fed Power Generation System under Different Quantities**  
Debin Zhang, Jijun Ma, Shengjia Wang, Yuhui Ji, Kun Jiang, Chengzhi Qu  
*Shanghai Instituted of Space Power-Sources (SISP), China*
- 17G3-2 Power Fluctuation Suppression by Current Balancing Control in Wind Power System Using Wound Rotor Induction Generator Under Unbalanced Grid Voltage**  
Kichiro Yamamoto, Takahiro Matsumoto, Atsushi Shinohara  
*Kagoshima University, Japan*
- 17G3-3 Sensorless Control of PMSG Wind Power Systems Based on ROGI-FLL**  
Anh Tan Nguyen<sup>1</sup>, Van Nam Nguyen<sup>2</sup>, Dong-Choon Lee<sup>2</sup>  
1) *Hanoi University of Science and Technology, Vietnam*, 2) *Yeungnam University, Korea*
- 17G3-4 Maximum Torque per Ampere Control of IPMSM Using Online Flux Linkage Plane Estimation Considering Cross Saturation**  
Suzuka Sasayama<sup>1</sup>, Yuki Shimizu<sup>2</sup>, Shigeo Morimoto<sup>3</sup>, Yukinori Inoue<sup>3</sup>, Masayuki Sanada<sup>3</sup>  
1) *Osaka Prefecture University, Japan*, 2) *Ritsumeikan University, Japan*, 3) *Osaka Metropolitan University, Japan*
- 17G3-5 Online Identification of Six-Phase IPMSM Parameters Using Prediction-Error Sensitivities to Model Parameters**  
Aravinda Perera, Roy Nilsen  
*Norwegian University of Science and Technology, Norway*

### **Session 17H3 PM machines II**

**Chairs:** Yoshihiro Miyama (*Mitsubishi Electric Corporation, Japan*)  
Yi Sui (*Harbin Institute of Technology, China*)

- 17H3-1 Imbalanced Force Suppression Due to Static Eccentricity by Using Triple Three-phase Winding Motor**  
Kan Yang<sup>1</sup>, Kan Akatsu<sup>1</sup>, Kodai Okazaki<sup>2</sup>, Yoshihiro Miyama<sup>2</sup>  
1) *Yokohama National University, Japan*, 2) *Mitsubishi Electric Corporation, Japan*
- 17H3-2 A Comparison of Permanent-Magnet Vernier Motor and Interior Permanent-Magnet Motor for Hybrid Electric Vehicles**  
Libing Cao<sup>1</sup>, Yuefei Zuo<sup>1</sup>, Shuangchun Xie<sup>1</sup>, Chi Cuong Hoang<sup>2</sup>, Boon Siew Han<sup>2</sup>, Christopher H. T. Lee<sup>1</sup>  
1) *Nanyang Technological University, Singapore*, 2) *Schaeffler (Singapore) Pte. Ltd., Singapore*
- 17H3-3 A Permanent Magnet Synchronous Machine with Interior Halbach Arrays**  
Yuting Gao<sup>1</sup>, Takashi Kosaka<sup>1</sup>, Yang Liu<sup>2</sup>, You Zhou<sup>3</sup>  
1) *Nagoya Institute of Technology, Japan*, 2) *Huazhong University of Science and Technology, China*, 3) *Nanyang Technological University, Singapore*
- 17H3-4 Performance Analysis of Flux-Modulating Consequent Pole Motors**  
Hiroshi Mitsuda<sup>1,2</sup>, Tadashi Fukami<sup>2</sup>, Masato Koyama<sup>2</sup>, Kazumasa Ito<sup>1</sup>  
1) *Mitsubishi Electric Corporation, Japan*, 2) *Kanazawa Institute of Technology, Japan*
- 17H3-5 Prototype Tests of Induction/Synchronous Magnetic Gears**  
Yuma Mizuana<sup>1</sup>, Kenji Nakamura<sup>1</sup>, Yuma Suzuki<sup>2</sup>, Yuichi Tachiya<sup>2</sup>, Kingo Kuritani<sup>2</sup>  
1) *Tohoku University, Japan*, 2) *Prospine Co., Ltd., Japan*

Room A

**Session 18A1 Renewable Energy Integration by Next-generation Power Electronics Technology (OS)**

**Chairs:** Kazunori Hasegawa (*Kyushu Institute of Technology, Japan*)

Kentaro Fukushima (*Central Research Institute of Electric Power Industry, Japan*)

**18A1-1 Net-Zero Emissions Energy Systems in an Internet of Energy (IoE) Society**

*Invited Paper* Hiroshi Asano<sup>1,5</sup>, Daisuke Iioka<sup>2</sup>, Osamu Kunitomo<sup>3</sup>, Yu Nagatomi<sup>4</sup>

1) Gifu University, Japan, 2) Chubu University, Japan, 3) Energy Public Group, Tokyo Gas Co., Ltd., Tokyo, Japan, 4) The Institute of Energy Economics, Japan, 5) CRIEPI, Japan

**18A1-2 Analytical study on energy scenarios and targets for 2050 in Japan**

*Invited Paper* Shigeru Bando<sup>1</sup>, Kentaro Fukushima<sup>1</sup>, Masaaki Takagi<sup>1</sup>, Hiroshi Asano<sup>1,2</sup>, Seiya Abe<sup>3</sup>, Daisuke Iioka<sup>4</sup>, Dai Orihara<sup>5</sup>

1) Central Research Institute of Electric Power Industry, Japan, 2) Gifu University, Japan, 3) Kyushu Institute of Technology, Japan, 4) Chubu University, Japan, 5) National Institute of Advanced Industrial Science and Technology, Japan

**18A1-3 Study of the Current Potential of Power Converters -Applied Power Semiconductor Devices, Power Density and Losses-**

*Invited Paper*

Seiya Abe<sup>1</sup>, Kentaro Fukushima<sup>2</sup>, Daisuke Iioka<sup>3</sup>, Dai Orihara<sup>4</sup>

1) Kyushu Institute of Technology, Japan, 2) Central Research Institute of Electric Power Industry, Japan, 3) Chubu University, Japan, 4) National Institute of Advanced Industrial Science and Technology, Japan

**18A1-4 Universal Smart Power Module (USPM) for Carbon Neutral Society**

*Invited Paper* Yoshikazu Takahashi<sup>1</sup>, Yoshinari Ikeda<sup>2</sup>, Hiroki Watanabe<sup>3</sup>, Jun-ichi Itoh<sup>3</sup>

1) Tohoku University, Japan, 2) Fuji Electric Co., Ltd, Japan, 3) Nagaoka University of Technology, Japan

**18A1-5 Control Method for Single-Phase Active Filter Using Universal Smart Power Module (USPM)**

*Invited Paper*

Mana Sakamoto, Hitoshi Haga

Nagaoka University of Technology, Japan

Room B

**Session 18B1 Advanced Motor Drive Technology for Future (OS)**

**Chairs:** Takahiro Suzuki (*Hitachi Ltd., Japan*)

Atsushi Matsumoto (*Chubu University, Japan*)

**18B1-1 Evaluation of Stator Current Power Spectrum Before and After Equipment Maintenance for Anomaly Detection of Induction Machine**

*Invited Paper*

Makoto Kaneamru, Ken Hirakida, Hiroshi Inoue, Toshihiko Miyauchi  
Mitsubishi Electric Corporation, Japan

**18B1-2 Experimental Evaluation of an AI Model Trained with Switching Pattern Based on Long-Horizon Model Predictive Control**

*Invited Paper*

Tenjiro Hiwatari, Akira Satake, Sota Sano, Kenya Sugihara, Ryo Yamamoto  
Mitsubishi Electric Corporation, Japan

**18B1-3 Self-Tuning for each PMSM Controller using Big Data based ANN**

*Invited Paper*

Sari Maekawa  
SEIKEI University, Japan

**18B1-4 Implementation of Vector Control System On Multi-Core Processor by Using Model-Based Parallelization Tool**

*Invited Paper*

Jinsoo Kim<sup>1</sup>, Shota Sagae<sup>1</sup>, Masato Eda<sup>1</sup>, Shinya Honda<sup>2</sup>, Shinji Doki<sup>1</sup>  
1) Nagoya University, Japan, 2) Nanzan University, Japan

**18B1-5 Motor-Current-Based Prediction of Bearing Degradation with Kalman Filter and Grease Lifetime Formula**

*Invited Paper*

Akari Kubo, Kohji Maki  
Hitachi Ltd., Japan

### **Session 18C1 Advanced motion control and its applications (OS)**

**Chairs:** Yoshiyuki Urakawa (*Nippon Institute of Technology, Japan*)

    Takenori Atsumi (*Chiba Institute of Technology, Japan*)

**18C1-1 Stochastic Learning Control Framework in the Integrated Frequency and Position Domain**

*Invited Paper* Hanul Jung, Sehoon Oh  
*Daegu Gyeongbuk Institute of Science and Technology, Korea*

**18C1-2 Robotic Arm Trajectory Generation Based on Emotion and Kinematic Feature**

*Invited Paper* Kaiwen Wu<sup>1,2,3</sup>, Luefeng Chen<sup>1,2,3</sup>, Kuanlin Wang<sup>1,2,3</sup>, Min Wu<sup>1,2,3</sup>, Witold Pedrycz<sup>4</sup>, Kaoru Hirota<sup>5</sup>  
1) *China University of Geosciences, China*, 2) *Hubei Key Laboratory of Advanced Control and Intelligent Automation for Complex Systems, China*, 3) *Ministry of Education, China*, 4) *University of Alberta, Canada*, 5) *Tokyo Institute of Technology, Japan*

**18C1-3 Loop-Shaping Technique for Quadruple-Stage-Actuator System in Hard Disk Drive**

*Invited Paper* Takenori Atsumi<sup>1</sup>, Shota Yabui<sup>2</sup>  
1) *Chiba Institute of Technology, Japan*, 2) *Tokyo City University, Japan*

**18C1-4 Application of Multilayer Kalman Filter to a Flexible Drive System**

*Invited Paper* Krzysztof Szabat<sup>1</sup>, Karol Wrobel<sup>1</sup>, Seiichiro Katsura<sup>2</sup>  
1) *Wroclaw University of Sciences and Technology, Poland*, 2) *Keio University, Japan*

**18C1-5 Robust interference suppression of three phase structural uncertainty inverter system based on equivalent input interference method**

*Invited Paper* Meng Ye<sup>1,2,3</sup>, Min Ding<sup>1,2,3</sup>, Danyun Li<sup>1,2,3</sup>, Zhijian Fang<sup>1,2,3</sup>, Qingyi Wang<sup>1,2,3</sup>, Luefeng Chen<sup>1,2,3</sup>  
1) *China University of Geosciences, China*, 2) *Hubei Key Laboratory of Advanced Control and Intelligent Automation for Complex Systems, China*, 3) *Ministry of Education, China*

### **Session 18D1 Smart Facilities**

**Chairs:** Takaharu Ishida (*Meisei University, Japan*)

    Yoshikazu Fukuyama (*Meiji University, Japan*)

**18D1-1 Refrigerated Showcase Fault Detection by an Artificial Neural Network using Correntropy with Improved Adaptive Kernel Size Tuning**

Masato Igarashi<sup>1</sup>, Yoshikazu Fukuyama<sup>1</sup>, Yuichi Shimasaki<sup>2</sup>, Yuto Osada<sup>2</sup>, Kenya Murakami<sup>2</sup>, Tatsuya Iizaka<sup>2</sup>, Adamo Santana<sup>2</sup>, Tetsuro Matsui<sup>2</sup>  
1) *Meiji University, Japan*, 2) *Fuji Electric Co., Ltd., Japan*

**18D1-2 Improvement of the Accuracy of Photovoltaic Module Equivalent Circuit Model using Irradiance-dependent Variable Shunt Resistor**

Kenji Arimatsu<sup>1</sup>, Yoichi Sekiba<sup>2</sup>, Hitoshi Haga<sup>3</sup>  
1) *Tohoku Electric Power Co., Inc., Japan*, 2) *Denryoku Computing Center, Ltd., Japan*, 3) *Nagaoka University of Technology, Japan*

**18D1-3 Novel Optimization Method Hybridized by MILP and PSO for Operation Planning in Microgrid System**

Yu Tanahashi<sup>1,2</sup>, Hiroshi Kobayashi<sup>1</sup>, Yuta Nakamura<sup>2</sup>, Mutsumi Aoki<sup>2</sup>  
1) *TOENEC CORPORATION, Japan*, 2) *Nagoya Institute of Technology, Japan*

**18D1-4 Data-Driven Hybrid Approach for Early Fault Detection of AHU using Electrical Signals**

Hasmat Malik<sup>1</sup>, Sanjib Kumar Panda<sup>2</sup>, Kameshwar Poolla<sup>3</sup>, Costas J. Spanos<sup>3</sup>  
1) *National University of Singapore, Singapore*, 2) *Berkeley Education Alliance for Research in Singapore (a research center of the University of California, Berkeley, USA), Singapore*, 3) *University of California, Berkeley, USA*

**18D1-5 Work Element Estimation for Forklift Operation**

Toshimasa Aso  
*Tokyo University of Marine Science and Technology, Japan*

### **Session 18E1 DC-DC Converters II**

**Chairs:** Kazuhiro Umetani (*Okayama University, Japan*)

Jun Imaoka (*Nagoya University, Japan*)

- 18E1-1 Integrated Coupled-Inductor Based Current and Voltage Balancing Technique for Parallel-Connected Triple-Active-Bridge Converters**  
Seunghoon Lee, Honnyong Cha, Kisu Kim  
*Kyungpook National University, Korea*
- 18E1-2 A Dual-Active-Bridge (DAB) Converter Based Bidirectional DC/DC Converter with Reduced Link Capacitance**  
Dongmin Choi, Minsu Lee, Taewoo Kim, Dongmin Kim, Gun-Woo Moon  
*Korea Advanced Institute of Science and Technology (KAIST), Korea*
- 18E1-3 Design and Characterization of a 500 kW 20 kHz Dual Active Bridge using 1.2 kV SiC MOSFETs**  
Fabian Sommer<sup>1</sup>, Nikolas Menger<sup>1</sup>, Tobias Merz<sup>1</sup>, Nils Soltau<sup>2</sup>, Shiori Idaka<sup>2</sup>, Marc Hiller<sup>1</sup>  
*1) Karlsruhe Institute of Technology, Germany, 2) Mitsubishi Electric Europe B.V., Germany*
- 18E1-4 Improvement of Efficiency in Bidirectional DC-DC Converter with Dual Active Bridge Using GaNHEMT**  
Ryuji Yamada<sup>1</sup>, Akihiro Hino<sup>1</sup>, Keiji Wada<sup>2</sup>  
*1) Fuji Electric Co., Ltd., Japan, 2) Tokyo Metropolitan University, Japan*
- 18E1-5 Low Temperature Investigation of a Cascode GaN based Resonant Bi-directional DC/DC Converter**  
Yuqi Wei, Md Maksudul Hossain, H. Alan Mantooth  
*University of Arkansas, USA*

### **Session 18F1 Railway Power Supply Systems**

**Chairs:** Satoru Hatsukade (*Railway Technical Research Institute, Japan*)

Takashi Suzuki (*East Japan Railway Company, Japan*)

- 18F1-1 1000kW DC/DC Converter Development for DC Traction Stationary BESS Considering Various Operation Power Patterns**  
Wataru Kawamura<sup>1</sup>, Junya Konno<sup>1</sup>, Akihiko Sumiya<sup>2</sup>  
*1) Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan, 2) Toshiba Infrastructure Systems & Solutions Corporation, Japan*
- 18F1-2 Developed energy saving control method for SESS**  
Hirotaka Takahashi, Tsutomu Miyauchi, Motonari Suzuki  
*Hitachi, Ltd, Japan*
- 18F1-3 Confirmation of Correlation between Hourly Electric Power and Instantaneous Maximum Power of Rectifiers for Railway**  
Shota Ishizaki<sup>1</sup>, Takashi Suzuki<sup>2</sup>, Masashi Nakahira<sup>2</sup>, Daisuke Kumagai<sup>2</sup>, Hiroto Amata<sup>2</sup>, Keiichiro Kondo<sup>3</sup>, Kota Sato<sup>3</sup>, Hitoshi Hayashiya<sup>2</sup>  
*1) Japan Railway Electric Design Co., Ltd., Japan, 2) East Japan Railway Company, Japan, 3) Waseda University, Japan*
- 18F1-4 The converter restart sequence of electronic frequency converters for the Tokaido Shinkansen at a transient fault on the power receiving side**  
Haruna Ohnishi<sup>1</sup>, Koji Otsuka<sup>1</sup>, Yuto Uchiyama<sup>1</sup>, Katsuyasu Nakano<sup>1</sup>, Masahiko Kai<sup>1</sup>, Takumi Nagai<sup>2</sup>, Naoya Tanigawa<sup>3</sup>  
*1) Central Japan Railway Company, Japan, 2) Toshiba Infrastructure Systems & Solutions Corporation, Japan, 3) Mitsubishi Electric Corporation, Japan*

## **Session 18G1 Recent Technologies of Home and Consumer Appliances for Decarbonization (OS)**

**Chairs:** Hideki Omori (*Kobe University, Japan*)

Yu-Chen Chang (*National Taiwan University of Science and Technology, Taiwan*)

### **18G1-1 Induction Heating Cookers: A Path Towards Decarbonization Using Energy Saving Cookers**

*Invited Paper* Oscar Lucia, Hector Sarnago, Jesus Acero, Claudio Carretero, Jose M. Burdio  
*University of Zaragoza, Spain*

### **18G1-2 Design and Implementation of a High-Power Modular WPT System**

*Invited Paper* Wenxing Zhong, Chen Zhu, Dehong Xu, Changsheng Hu  
*Zhejiang University, China*

### **18G1-3 Design and Implementation of a Single Phase Inverter in Residential Storage System**

*Invited Paper* Ta-Wei Huang, Chang-Tsai Tsai, Yu-Chen Chang, Huang-Jen Chiu  
*National Taiwan University of Science and Technology, Taiwan*

### **18G1-4 A Local VPP with EVs in Very Small Areas**

*Invited Paper* Yoshimitchi Nakamura<sup>1</sup>, Hideki Omori<sup>2</sup>  
1) *Smart Energy Laboratory, Japan*, 2) *Kobe University, Japan*

### **18G1-5 V2X products and social implementation in Japan -future prospects from the point of "Global warming problem"**

*Invited Paper* Shunjiro Yui, Hiroshi Seki, Katsuhiko Furuya, Hiroto Nakamura  
*Nichicon Co., Ltd., Japan*

## **Session 18H1 Wireless power transfer for Automobiles**

**Chairs:** Kantaro Yoshimoto (*Tokyo Denki University, Japan*)

Shingo Soma (*Honda R&D Co.,Ltd., Japan*)

### **18H1-1 Novel Dynamic Wireless Power Transfer System for Battery Electric Vehicles Using In-Tire and In-Wheel Repeater Coil**

Hayato Sumiya<sup>1,2</sup>, Eisuke Takahashi<sup>1</sup>, Nobuhisa Yamaguchi<sup>1</sup>, Keisuke Tani<sup>1</sup>, Osamu Shimizu<sup>2</sup>, Sakahisa Nagai<sup>2</sup>, Hiroshi Fujimoto<sup>2</sup>, Daisuke Gunji<sup>3</sup>, Isao Kuwayama<sup>4</sup>  
1) *DENSO CORPORATION, Japan*, 2) *The University of Tokyo, Japan*, 3) *NSK Ltd., Japan*, 4) *Bridgestone Corporation, Japan*

### **18H1-2 Wireless recharging of EVs while driving and the effectiveness of novel storage battery**

Shigeyuki Takagi<sup>1</sup>, Suguru Kawamura<sup>1</sup>, Akito Sasaki<sup>2</sup>, Hideaki Hirabayashi<sup>2</sup>  
1) *Tokyo University of Technology, Japan*, 2) *Toshiba Materials Co., Ltd., Japan*

### **18H1-3 Wireless EV Charging System Using PWM Controlled Variable Capacitor for Maximum Power Transfer under Severe Coil Misalignment**

Ryo Matsumoto, Hiroshi Fujimoto  
*The University of Tokyo, Japan*

### **18H1-4 Variable Frequency Control for Constant Current Constant Voltage Inductive Wireless EV Charging System**

Thanet Sriprom<sup>1</sup>, Anon Namin<sup>1</sup>, Wuttikai Tammawan<sup>1</sup>, Samart Yachiangkam<sup>1</sup>, Suchart Janjornmanit<sup>1</sup>, Uthen Kamnarn<sup>1</sup>, Jutturit Thongpron<sup>1</sup>, Chanyut Karnjanapiboon<sup>1</sup>, Phatiphat Thounthong<sup>2</sup>, Noureddine Takorabet<sup>3</sup>  
1) *Rajamangala University of Technology Lanna (RMUTL), Thailand*, 2) *King Mongkut's University of Technology, Thailand*, 3) *Université de Lorraine, France*

Room A

**Session 18A2 Advance Control for Power Converters (OS)**

**Chairs:** Ching-Jan Chen (*National Taiwan University, Taiwan*)

Hiroki Watanabe (*Nagaoka University of Technology, Japan*)

**18A2-1 An Arithmetic Series-Based Recursive Equation Used in the Approximation of the Sinusoidal Wave with Reduced Error**

*Invited Paper*

Xiao-Ze Lin, Woei-Luen Chen  
*Senior Member IEEE*

**18A2-2 Design of an Interleaved Half-Bridge CLLC Resonant AC-AC Converter**

*Invited Paper*

Kuo-Yuan Lo, Shin-Yue Chen, You-Xuan Guo  
*National Kaohsiung University of Science and Technology, Taiwan*

**18A2-3 An Optimal Frequency-Modulated Control for Bidirectional CLLC Resonant Converters**

*Invited Paper*

Cheng-Yu Tang, Tzu-Hsuan Ho  
*National Taipei University of Technology, Taiwan*

**18A2-4 Online Grid Impedance Measurement Based on Virtual Reference Axis**

*Invited Paper*

Meng-Chun Yang<sup>1</sup>, Zhe-Yan Chen<sup>1</sup>, Yaow-Ming Chen<sup>1</sup>, Chih-Chao Hsu<sup>2</sup>  
1) *National Taiwan University, Taiwan*, 2) *National Chung-Shan Institute of Science and Technology, Taiwan*

**18A2-5 A 4-MHz Ultra-Fast Transient Response Capacitor Current Adaptive On-Time (CCAOT) Controlled Buck Converter with Passive Ramp Compensation**

*Invited Paper*

Yu-Lin Chao, Chieh-Ju Tsai, Ching-Jan Chen  
*National Taiwan University, Taiwan*

Room B

**Session 18B2 Key Technologies Towards High-speed Electrical Machines (OS)**

**Chairs:** Jing Ou (*Harbin Institute of Technology, China*)

Hongfei Lu (*Karlsruhe Institute of Technology, Germany*)

**18B2-1 Analytical Computation of Inductance for High-Speed Spoke-Type Permanent Magnet Synchronous Motor**

*Invited Paper*

Accounting for Saturation  
Peixin Liang<sup>1,2</sup>, Tianrong He<sup>1,2</sup>, Lihao Liang<sup>1,2</sup>, Dingxuan Yue<sup>1</sup>, Ningfei Jiao<sup>1,2</sup>, Weiguo Liu<sup>1,2</sup>,  
1) *Northwestern Polytechnical University, China*, 2) *Shaanxi Key Laboratory of Small & Special Electrical Machine and Drive Technology, China*

**18B2-2 Design of a high-speed synchronous reluctance motor made of dual-phase steel**

*Invited Paper*

Jing Ou<sup>1</sup>, Jingbo Lin<sup>1</sup>, Feng Chai<sup>1</sup>, Dianguo Xu<sup>1</sup>, Martin Doppelbauer<sup>2</sup>  
1) *Harbin Institute of Technology, China*, 2) *Karlsruhe Institute of Technology, Germany*

**18B2-3 Mechanical Design of a High-Speed Permanent Magnet Assisted Electrically Excited Synchronous Machine as Traction Motor**

*Invited Paper*

Hongfei Lu, Johannes Deutsch, Martin Doppelbauer  
*Karlsruhe Institute of Technology (KIT), Germany*

**18B2-4 Vibration characteristic analysis and comparison of high-speed switched reluctance motor with amorphous alloy core**

*Invited Paper*

Feng Chai<sup>1</sup>, Mengsen Hu<sup>1</sup>, Zongyang Li<sup>2</sup>, Lina Geng<sup>1</sup>  
1) *Harbin Institute of Technology, China*, 2) *Midea Welling Motor Technology (Shanghai) Co., Ltd., China*

## **Session 18C2 Renewable Energy Systems**

**Chairs:** Masahide Hojo (*Tokushima University, Japan*)

Danang Wijaya (*Universitas Gadjah Mada, Indonesia*)

- 18C2-1 A Low-Cost Grid-Connected Photovoltaic Microinverter Based on Commutation of Thyristor**  
Manlin Wang, Su Du  
*Central South University, Changsha, China*
- 18C2-2 A Control System of PV Sources for DC Microgrid with Seamless Switching Operation between I-V Droop Control and MPPT Control**  
Yasushi Eto, Yuichi Noge, Masahito Shoyama  
*Kyushu University, Japan*
- 18C2-3 The Impact of Sun Tracking on the Reliability of Solar Inverters**  
Ali Azizi<sup>1</sup>, Saeed Peyghami<sup>1</sup>, Seyed Fariborz Zarei<sup>2</sup>, Frede Blaabjerg<sup>1</sup>  
1) *Aalborg University, Denmark*, 2) *Qom University of Technology, Iran*
- 18C2-4 Testing Requirements and Control Strategies of Next-Generation Grid Emulator: A Review**  
Zejie Li, Pavani Ponnaganti, Fangzhou Zhao, Xiongfei Wang, Birgitte Bak-Jensen, Stig Munk-Nielsen, Frede Blaabjerg  
*Aalborg University, Denmark*
- 18C2-5 Islanded Wind Farm Microgrid Stability Control Using Synchronverter Algorithm**  
Mohd. Brado Frasetyo, Fransisco Danang Wijaya, Eka Firmansyah  
*Universitas Gadjah Mada, Indonesia*

## **Session 18D2 Industrial Instrumentation and Control III**

**Chairs:** Tomoyuki Shimono (*Yokohama National University, Japan*)

Masato Koyama (*Mie University, Japan*)

- 18D2-1 A Short-Distance Running Algorithm Based MPPT Control Strategy for PV Power Systems Under Partial Shading Conditions**  
Sy Ngo<sup>1,2</sup>, Chian-Song Chiu<sup>1</sup>  
1) *Chung Yuan Christian University, Taiwan*, 2) *Thu Dau Mot University, Vietnam*
- 18D2-2 Extrapolation of Band-Limited Frequency Responses for Out-of-Band Modal Synthesis**  
Weihua Zhou, Jef Beerten  
*KU Leuven & EnergyVille, Belgium*
- 18D2-3 Adaptive Protection Scheme with Passive Islanding Detection for AC Microgrids**  
Yingjia Luo, Inam Ullah Nutkani, Lasantha Meegahapola  
*RMIT University, Australia*
- 18D2-4 Average Consensus Problem in Multi-Agent System in an Environment with Obstacle**  
Hiroki Kimura, A. Okuyama  
*Tokai University, Japan*

## **Session 18E2 DC-DC Converters III**

**Chairs:** Yusuke Hayashi (*Toshiba Corporation, Japan*)

Daniel Siemaszko (*Hitachi Energy, Switzerland*)

- 18E2-1 A New Secondary Clamp Diode for Phase-Shift Full-Bridge Converter**  
Minsu Lee, Dongmin Choi, Juhyun Bae, Jongyoon Chae, Gun-Woo Moon  
*Korea Advanced Institute of Science and Technology (KAIST), Korea*
- 18E2-2 Experimental Insights into the MW Range Dual Active Bridge with Silicon Carbide Devices**  
Stefanie Heinig<sup>1</sup>, Daniel Siemaszko<sup>1</sup>, Remo Baumann<sup>1</sup>, Noemi Hubatka<sup>1</sup>, Martin Kläusler<sup>1</sup>, Raul Ruiz<sup>1</sup>, Ralph Burkart<sup>2</sup>, ChunMing Yuan<sup>3</sup>  
1) *Hitachi Energy, Switzerland*, 2) *Hitachi Energy Research, Switzerland*, 3) *Hitachi Energy Research, China*

- 18E2-3 MHz-Driving Snubberless Zero-Current Soft-Switching High Step-Up DC-DC Converter with Multi-Resonant Circuitry**  
Tomokazu Mishima<sup>1</sup>, Ryusei Miyazaki<sup>1</sup>, Ching-Ming Laia<sup>2</sup>  
1) Kobe University, Japan, 2) National Chung Hsing University, Taiwan
- 18E2-4 A Unified Modeling Approach for a Multi-Active Bridge Converter**  
Vishwabandhu Uttam, Vishnu Mahadeva Iyer  
Indian Institute of Science, India
- 18E2-5 A Novel Fault-Tolerant Control Strategy for Dual Active Bridge Converter under Open Circuit Fault**  
Ning Wang<sup>1</sup>, Yanbo Wang<sup>1</sup>, Zhe Chen<sup>1</sup>, Shilin Liu<sup>2</sup>  
1) Aalborg University, Denmark, 2) Anhui Polytechnic University, China

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### Room F

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#### Session 18F2 Power Electronics Technologies for Railways

**Chairs:** Ken Kunomura (*Central Japan Railway Company, Japan*)  
Keiichiro Kondo (*Waseda University, Japan*)

- 18F2-1 Control and Performance of Capacitively-Isolated Bidirectional DC-DC Converter with Auxiliary Converters for Electric Railways**  
Kana Matsumoto, Kazuaki Tesaki, Makoto Hagiwara  
Tokyo Institute of Technology, Japan
- 18F2-2 Overview of CLLC Modulation Strategy**  
Danni Yang, Yan Zhang, Xue Liu, Wanxing Wang, Jinjun Liu  
Xi'an Jiaotong University, China
- 18F2-3 Impedance Modeling and Harmonic Stability Analysis of MMC-Based Railway Static Power Conditioner**  
Pengkun Li, Yue Wang, Fengmo Li, Runtian Li, Bole Feng, Cheng Long  
Xi'an Jiaotong University, China
- 18F2-4 Transient Stability of Grid-Forming Converters with Flexible DC-Link Voltage Control**  
Liang Zhao<sup>1</sup>, Zheming Jin<sup>2</sup>, Xiongfei Wang<sup>1</sup>  
1) Aalborg University, Denmark, 2) Beijing Jiaotong University, China

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### Room G

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#### Session 18G2 Devices and DC-DC Converter for Home Appliances

**Chairs:** Toshiyuki Zaitzu (*ROHM Co., Ltd., Japan*)  
Nobuo Satoh (*Chiba Institute of Technology, Japan*)

- 18G2-1 Efficiency-Optimized Control Method for Multiport Converter with Current-Fed H-bridges**  
Mina Kim<sup>1</sup>, Hwa-Pyeong Park<sup>1</sup>, Seung Yeol Oh<sup>1</sup>, Jung Sik Choi<sup>1</sup>, Daeseak Cha<sup>1</sup>, Byoung-Sun Ko<sup>1</sup>, Jee-Hoon Jung<sup>2</sup>  
1) Korea Electronics Technology Institute (KETI), Korea, 2) Ulsan National Institute of Science and Technology (UNIST), Korea
- 18G2-2 Evaluation and Comparison of Dynamic ON-state Resistance Measurement Methods for GaN Devices**  
Rui Zhong, Huiqing Wen  
Xi'an Jiaotong-Liverpool University, China
- 18G2-3 State of Charge Estimation for Liquid Metal Batteries with Gaussian Process Regression Framework**  
Sheng Wang, Zehang Li, E Zhang, Min Zhou, Kangli Wang  
Huazhong University of Science and Technology, China
- 18G2-4 Design and Implementation of a High Step-Up DCDC Converter with Active Switched Inductor and Coupled Inductor**  
Peng Luo, Tsorng-Juu Liang, Kai-Hui Chen, Shih-Ming Chen  
National Cheng Kung University, Taiwan
- 18G2-5 A Non-Isolated Bidirectional DC-DC Converter with High Conversion Ratio**  
Tsorng-Juu Liang, Ru-Cian Lin, Peng Luo, Kai-Hui Chen  
National Cheng Kung University, Taiwan

## **Session 18H2 Design and Control of Energy Managing Converters for Automobiles**

**Chairs:** Osamu Shimizu (*The University of Tokyo, Japan*)

Nobuyuki Imai (*Honda R&D Co., Ltd., Japan*)

**18H2-1 Improved DC-Charging for Traction Drives with Hybrid Powered Dual Two-Level Inverter**

Kai Kuhlmann, Johannes Teigelkötter, Johannes Büdel, Christian Herkommer

*University of Applied Sciences Aschaffenburg, Germany*

**18H2-2 Variable Coupling Coefficient Integrated Inductor for Hybrid Energy Source Systems**

Masanori Ishigaki, Koji Shigeuchi, Naoki Yanagizawa, Daiki Nitta, Shuji Tomura

*Toyota Central R&D Labs., Inc., Japan*

**18H2-3 Dual Inverter Integrated DC Charging with Minimal Leakage Current Generation**

Sitan Wang, Mehanathan Pathmanathan, Peter W. Lehn

*University of Toronto, Canada*

**Wednesday, May 18: 16:00-18:05**

## **Session 18A3 System Integration Technology in Power Electronics (OS)**

**Chairs:** Kazuaki Mino (*Murata Manufacturing Co., Ltd., Japan*)

Neha NAIN (*ETH Zurich, Switzerland*)

**18A3-1 Consideration of Integrated Power Converter for Renewable Energy- Grid -BES Interactive Applications**

*Invited Paper* Goh Teck Chiang, Kyosuke Tanemura, Shuji Tomura

*Toyota Central R&D Labs. INC, Japan*

**18A3-2 The Potential of LLC Resonant Converters Equipped With Split Resonant Capacitors: From Three-Phase to Fractal Structures**

*Invited Paper*

Akiteru Chiba, Kazuto Takagi, Yuuki Aoyagi, Keita Ishikura

*GS Yuasa Infrastructure Systems Co., Ltd., Japan*

**18A3-3 High Power Density Design of Single-Phase AC/DC Converter with Active Power Decoupling Capability Utilizing Triangular Current Mode for LED Driver Applications**

*Invited Paper*

Hiroki Watanabe, Jun-ichi Itoh

*Nagaoka University of Technology, Japan*

**18A3-4 Comparative Evaluation of Three-Phase AC-AC Voltage/Current-Source Converter Systems Employing Latest GaN Power Transistor Technology**

*Invited Paper*

Neha Nain, Jonas Huber, Johann W. Kolar

*ETH Zurich, Switzerland*

**18A3-5 Comparative Evaluation of ARCP and Three-Level TCM Soft-Switching Bridge-Legs for High-Frequency SiC Converter Systems**

*Invited Paper*

Thomas Langbauer<sup>1</sup>, Spasoje Miric<sup>2</sup>, Michael Haider<sup>2</sup>, Jonas Huber<sup>2</sup>, Johann W. Kolar<sup>2</sup>

1) *Silicon Austria Labs GmbH, Austria*, 2) *ETH Zurich, Switzerland*

## **Session 18B3 Technical Trend of Magnetic-gearred Machines (OS)**

**Chairs:** Kenji Nakamura (*Tohoku University, Japan*)

Kyohei Kiyota (*Tokyo Institute of Technology, Japan*)

**18B3-1 Design of a 15-MW Magnetic-Geared Generator**

*Invited Paper*

Noboru Niguchi<sup>1</sup>, Katsuhiro Hirata<sup>1</sup>, Takuya Ito<sup>1</sup>, Haruyuki Kometani<sup>2</sup>, Ryoji Miyatake<sup>2</sup>, Atsushi Yamamoto<sup>2</sup>

1) *Osaka University, Japan*, 2) *Mitsubishi Electric Corporation, Japan*

**18B3-2 A Novel In-Wheel Motor Drive System of Multiple High-Speed Motors Integrated with Magnetic Gear for Electric Vehicle**

*Invited Paper*

Kohei Aiso<sup>1</sup>, Kan Akatsu<sup>2</sup>, Yasuaki Aoyama<sup>3</sup>

1) *Shibaura Institute of Technology, Japan*, 2) *Yokohama National University, Japan*, 3) *Hitachi, Ltd., Japan*

**18B3-3 Design of a Magnetic Geared Bearingless Slice Motor with Combined Windings**

*Invited Paper*

Wolfgang Gruber<sup>1</sup>, Tobias Konig<sup>2</sup>, Eva-Maria Miliker<sup>1</sup>

1) *Johannes Kepler University, Austria*, 2) *Linz Center of Mechatronics GmbH, Austria*

**18B3-4 Novel Reluctance-type Magnetic Geared Motor with Integrated with High-speed Bearingless Motor**

*Invited Paper*

Akira Kumashiro<sup>1</sup>, Akira Chiba<sup>1</sup>, Wolfgang Gruber<sup>2</sup>, Wolfgang Amrhein<sup>2</sup>, Gerald Jungmayr<sup>3</sup>

1) *Tokyo Institute of Technology, Japan*, 2) *Johannes Kepler University Linz, Austria*, 3) *Linz Center of Mechatronics GmbH, Austria*

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**Room C**

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**Session 18C3 New Generation Transformers**

**Chairs:** Takaaki Ibuchi (*Osaka University, Japan*)

Jing Lyu (*Shanghai Jiao Tong University, China*)

**18C3-1 Feasibility Study of High-Frequency Transformer with High-Voltage Insulation Structure for SST Based Medium-Voltage Multi-Level Converter**

Yuki Kawaguchi, Kimihisa Furukawa, Takae Shimada, Junpei Kusukawa

*Hitachi, Ltd., Japan*

**18C3-2 Analytical Capacitance Calculation for Transformers with Grounded Core**

Bastian Korthauer, Jürgen Biela

*Laboratory for High Power Electronic Systems (HPE) ETH Zurich, Switzerland*

**18C3-3 Study the Thermal Performance of the CLLC Transformer in the OBC Designed Using SiC MOSFETs**

Haoqi Zhu<sup>1</sup>, Naoto Fujishima<sup>2</sup>, Yuichi Onozawa<sup>2</sup>, Sideng Hu<sup>1</sup>

1) *Zhejiang University, China*, 2) *Fuji Electric Co., Ltd, Japan*

**18C3-4 An Integrated Transformer for LLC Resonant Converter Applications of Low Output Voltages and High Currents**

Philipp Rehlaender, Shobhit Sharma, Frank Schafmeister, Joachim Böcker

*Paderborn University, Germany*

**18C3-5 Electromagnetic Field and Energy Flux in Wireless Power Transfer System**

Itsuki Masuda, Manabu Ishitobi

*National Institute of Technology, Nara College, Japan*

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**Room D**

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**Session 18D3 HILS**

**Chairs:** Noriyasu Matsuno (*Myway Plus Corporation, Japan*)

Ke Ma (*Shanghai Jiao Tong University, China*)

**18D3-1 Virtual Capacitor Concept for Partitioning of Large Converter Systems for RT-HIL Simulations**

Philippe Bontemps, Stefan Milovanovic, Drazen Dujic

*École Polytechnique Fédérale de Lausanne (EPFL), Switzerland*

**18D3-2 Real-Time Simulation Method Using LPV Model of LLC Current Resonant Converter**

Hideaki Funaki<sup>1</sup>, Yuichi Noge<sup>1</sup>, Masahito Shoyama<sup>1</sup>, Yu Yonezawa<sup>2</sup>

1) *Kyushu University, Japan*, 2) *Nagoya University, Japan*

**18D3-3 A modular signal processing platform for grid and motor control, HIL and PHIL applications**

Benedikt Schmitz-Rode, Lukas Stefanski, Rüdiger Schwendemann, Simon Decker, Stefan Mersche, Philip Kiehnle,

Patrick Himmelmann, Andreas Liske, Marc Hiller

*Karlsruhe Institute of Technology (KIT), Germany*

**18D3-4 Mission Profile Emulator for Sub-Modules of Modular Multilevel Converter with Resonant Filter Impedance**

Enyi Li, Ke Ma

*Shanghai Jiao Tong University, China*

- 18D3-5 Disturbance Suppression for Mission Profile Emulator for Sub-Modules of Modular Multilevel Converter Under Nearest Level Modulation with Feedforward Control**  
Enyi Li, Ke Ma  
*Shanghai Jiao Tong University, China*

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**Room E**

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**Session 18E3 Control and Analysis of Dual Active Bridge Converters**

**Chairs:** Koji Orikawa (*Hokkaido University, Japan*)

Jian Yin (*Shenzhen University, China*)

- 18E3-1 Improved Phase-Shift Scheme for Fast Power Reversal in a Bidirectional Dual Active Bridge DC/DC Converter Considering the AC-Link Equivalent Resistance**  
Xiaochao He, Jian Yin  
*Shenzhen University, China*
- 18E3-2 Flux Control Modulation for Three-Phase Dual-Active Bridge DC-DC Converters**  
Niklas Fritz, David Heidenberger, David Bundgen, Rik W. De Doncker  
*RWTH Aachen University, Germany*
- 18E3-3 A Fast Direct Power Digital Control Strategy for Dual Active Bridge DC-DC Converters**  
L. James<sup>1</sup>, C.A. Teixeira<sup>1</sup>, R.W. Wilkinson<sup>1</sup>, B.P. McGrath<sup>1</sup>, S.A. Gonzalez<sup>2</sup>, M. Judewicz<sup>2</sup>, P. Sokolowski<sup>1</sup>  
*1) RMIT University, Australia, 2) Universidad Nacional de Mar del Plata (UNMDP), Argentina*
- 18E3-4 A Transient Characteristics Improvement Method in Dual Active Bridge Converter with Multilevel Inverter Topology**  
Yasunobu Ueuchi, Nobukazu Hoshi, Takanobu Ohno  
*Tokyo University of Science, Japan*
- 18E3-5 Real-time Power Flow Decoupling of Triple-Active-Bridge Converter for DC Microgrid System Applications**  
Kwabena Opoku Bempah, Kyung-Wook Heo, Jee-Hoon Jung  
*Ulsan National Institute of Science and Technology, Korea*

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**Room F**

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**Session 18F3 Railway Vehicles**

**Chairs:** Shingo Makishima (*Toyo Denki Seizo K. K., Japan*)

Yoshiyasu Hagiwara (*Mitsubishi Electric Corporation, Japan*)

- 18F3-1 A Novel Maximum Adhesive Force Control without Vehicle Speed Sensor**  
Kanta Horikoshi, Kantaro Yoshimoto, Tomoki Yokoyama  
*Tokyo Denki University, Japan*
- 18F3-2 Power Generation Control Method of Parallel Resonant PMSG System for Series Hybrid Vehicle**  
Shunsuke Jindo<sup>1</sup>, Keiichiro Kondo<sup>1</sup>, Minoru Kondo<sup>2</sup>, Toshihide Yokouchi<sup>2</sup>  
*1) Waseda University, Japan, 2) Railway Technical Research Institute, Japan*
- 18F3-3 A Method to Design Capacity of Onboard Energy Storage Device for Emergency Operation Based on Effective Balance of Power and Energy**  
Hiroyasu Kobayashi<sup>1</sup>, Keiichiro Kondo<sup>2</sup>, Masafumi Miyatake<sup>3</sup>, Takafumi Koseki<sup>4</sup>  
*1) Chiba University, Japan, 2) Waseda University, Japan, 3) Sophia University, Japan, 4) The University of Tokyo, Japan*
- 18F3-4 Study on the feeder voltage control with adjusting power factor of train's power converters under multiple trains running in the same feeder section**  
Hiroshi Moriyama, Ken Kunomura, Kenji Sato, Toshiaki Takami, Toyokazu Hamajima, Toshimasa Shimizu, Takuya Yamagiwa  
*Central Japan Railway Company, Japan*

### **Session 18G3 Grid Connected Systems related to Home Appliances**

**Chairs:** Kaoru Inoue (*Doshisha University, Japan*)

Yun Yang (*The University of Hong Kong, China*)

**18G3-1 Efficiency Optimization Method for Parallel Converters in Fault-tolerant Microgrids**

Pengwei Li, Ali M. Bazzi

*University of Connecticut Storrs, USA*

**18G3-2 A Power Oscillation Damping Method for Virtual Synchronous Generators Based on Frequency Feedforward in Voltage Reference**

Jiazhi Wang, Zeng Liu, Yidong Shi, Jinjun Liu

*Xi'an Jiaotong University, China*

**18G3-3 Dynamic and Steady-State Behavior of Distributed Power Supply in DC Architecture with Minimized DC Bus Capacitor**

Pakawadee Wutthiwai<sup>1</sup>, Uthen Kamnarn<sup>1</sup>, Jedsada Yodwong<sup>2</sup>, Anon Namin<sup>1</sup>, Phatiphath Thounthong<sup>3</sup>,  
Noureddine Takorabet<sup>4</sup>

*1) Rajamangala University of Technology Lanna, Thailand, 2) mu Space and Advanced Technology Company Limited, Thailand, 3) King Mongkut's University of Technology North Bangkok, Thailand, 4) Université de Lorraine, France*

**18G3-4 ADALINE Current Control for Single-Phase Active Power Filter**

Sarawut Janpong<sup>1</sup>, Nanthi Suthikarnnarunai<sup>2</sup>, Somboon Sooksatra<sup>1</sup>, Keratiya Janpong<sup>3</sup>

*1) Rangsit University, Thailand, 2) University of the Thai Chamber of Commerce, Thailand, 3) Maejo University, Thailand*

### **Session 18H3 Battery related technologies for Automobile**

**Chairs:** Hiroaki Matumori (*Nagoya Institute of Technology*)

Nobuyuki Imai (*Honda R&D Co., Ltd., Japan*)

**18H3-1 Research on High-Power Rapid Charge Approach for EV Based on Clustered Multi-node Learning Gaussian Process**

Liguo Wang<sup>1</sup>, Zhenteng Tian<sup>1</sup>, Yuanting Hu<sup>2</sup>, Chunlai Yu<sup>2</sup>, Zongjie Wang<sup>3</sup>, Feng Gao<sup>4</sup>

*1) Harbin Institute of Technology, China, 2) State Grid Heilongjiang Electric Power Co., Ltd, China, 3) University of Connecticut, USA, 4) North Minzu University, China*

**18H3-2 Remaining Useful Life Prediction Considering Operating Condition Change Based on Regression and Empirical Mode Decomposition**

Hyeon Ho Lee, Dong Hwan Kim, Tae-Won Noh, Byoung Kuk Lee

*Sungkyunkwan University, Korea*

**18H3-3 Study on Power Source Properties Suitable for Volume Minimization in Electric Vehicle Hybrid Power-Source System**

Shunya Sakamoto<sup>1</sup>, Atsushi Okada<sup>1</sup>, Kensuke Sasaki<sup>1</sup>, Takashi Kato<sup>1</sup>, Keiichiro Kondo<sup>2</sup>, Ryo Kimura<sup>2</sup>

*1) Nissan Motor Co., Ltd, Japan, 2) Waseda University, Japan*

**18H3-4 An RLS Based Battery Modeling Method to Compensate for Recovery Effect in Battery Balancing**

Yiqing Lu, Haoyu Wang, Hengzhao Yang, Shaojie Chen, Wei Liu

*ShanghaiTech University, China*

Room A

**Session 19A1 Modeling and Simulation Techniques for Power Electronics (OS)**

**Chairs:** Koichi Shigematsu (*Nagoya University, Japan*)  
Jongwon Shin (*Chung-Ang University, Korea*)

**19A1-1 Practical Modeling and Simulation Techniques for Power Electronics**

*Invited Paper* Hiroki Ishikawa  
Gifu University, Japan

**19A1-2 Simulating Wide Bandgap FET Models in LTspice**

*Invited Paper* Jong-Won Shin, Joonho Shin  
Chung-Ang University, Korea

**19A1-3 Difficulty and solution in transient thermal resistance measurement for wide band gap power semiconductor device**

*Invited Paper* Tsuyoshi Funaki<sup>1</sup>, Shuhei Fukunaga<sup>1</sup>, Tomoaki Hara<sup>2</sup>, Takaaki Ibuchi<sup>1</sup>  
1) Osaka University, Japan, 2) Siemens AG, Japan

**19A1-4 An Investigation and Proposal for Accurate Leakage Inductance Modeling Based on Dowell Model**

*Invited Paper* Yu-Hsin Wu<sup>1</sup>, Koichi Shigematsu<sup>1</sup>, Yasumichi Omoto<sup>2</sup>, Jun Imaoka<sup>1</sup>, Masayoshi Yamamoto<sup>1</sup>  
1) Nagoya University, Japan, 2) NIDEC MOBILITY CORPORATION, Japan

**19A1-5 Numerical Methods for the Periodic AC Analysis of DC Power Converters**

*Invited Paper* Noel Delgado<sup>1</sup>, Alan Courta<sup>2</sup>, Datsen Davies Tharakan<sup>3</sup>  
1) Raytheon Missiles & Defense, USA, 2) Synopsys, USA, 3) Synopsys, India

Room B

**Session 19B1 Technical Trend of Next-generation Application Specific Electric Motors (OS)**

**Chairs:** Yoshinari Asano (*Daikin Industries Ltd., Japan*)  
Yuting Gao (*Nagoya Institute of Technology, Japan*)

**19B1-1 Technical Trend of Next-generation Application Specific Electric Motors**

*Invited Paper* Osamu Shimizu<sup>1</sup>, Yosuke Kawazoe<sup>2</sup>, Sho Uchiyama<sup>3</sup>, Yoshihiro Miyama<sup>4</sup>, Hideo Dohmeki<sup>5</sup>, Takashi Nakagami<sup>6</sup>, Tsuyoshi Miyaji<sup>7</sup>, Kyohei Kiyota<sup>8</sup>  
1) The University of Tokyo, Japan, 2) Yasukawa Electric Corporation, Japan, 3) Meidensha Corporation, Japan, 4) Mitsubishi Electric Corporation, Japan, 5) Tokyo City University, Japan, 6) Mitsubishi Heavy Industry, Japan, 7) Aisin Corporation, Japan, 8) Tokyo Institute of Technology, Japan

**19B1-2 Latest Technical Trend of Miniaturization, Weight Reduction, and High Efficiency of Electric Motors by Increasing the Rotational Speed**

*Invited Paper* Akio Toba<sup>1</sup>, Masanori Arata<sup>2</sup>, Masayuki Sanada<sup>3</sup>, Yoshiaki Kano<sup>4</sup>, Tatsuya Tonari<sup>5</sup>  
1) Fuji Electric Co., Ltd., Japan, 2) Chu-o University, Japan, 3) Osaka Prefecture University, Japan, 4) Daido University, Japan, 5) Daikin Industries, Ltd., Japan

**19B1-3 Latest Technical Trend of Miniaturization, Weight Reduction and High Efficiency of Electric Motors by Applying New Topology**

*Invited Paper* Takashi Kosaka<sup>1</sup>, Yoshihiro Miyama<sup>2</sup>, Hajime Ukaji<sup>3</sup>, Kensuke Sasaki<sup>4</sup>, Yuji Yamamoto<sup>5</sup>, Yuichi Yokoi<sup>6</sup>  
1) Nagoya Institute of Technology, Japan, 2) Mitsubishi Electric Corporation, Japan, 3) Panasonic Corporation, Japan, 4) Nissan Motor Co., Ltd., Japan, 5) Toshiba Industrial Products and Systems Corporation, Japan, 6) Nagasaki University, Japan

**19B1-4 Latest Technical Trend for Miniaturization, Weight Reduction, and High Efficiency by Applying New Materials**

*Invited Paper* Shoji Shimomura<sup>1</sup>, Yuji Enomoto<sup>2</sup>, Masayuki Morimoto<sup>3</sup>, Yasuhiro Marukawa<sup>4</sup>, Kiyoshi Wajima<sup>5</sup>, Takao Yabumi<sup>6</sup>, Tomoyuki Okubo<sup>7</sup>, Tatsuya Saito<sup>8</sup>  
1) Shibaura Institute of Technology, Japan, 2) Hitachi, Ltd., Japan, 3) Tokai University, Japan, 4) Hitachi Metals, Ltd, Japan, 5) Nippon Steel Corporation, Japan, 6) Daido Steel, Japan, 7) JFT Steel Corporation, Japan, 8) Sumitomo Electric Industries, Ltd, Japan

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## Room C

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### Session 19C1 Applications of Solid-State Device for Power System

Chairs: Takanori Isoke (*University of Tsukuba, Japan*)

Krishna Raj Potti (*Indian Institute of Technology Delhi, India*)

- 19C1-1 Resistive Superconducting Fault Current Limiter - Integrated Bidirectional Hybrid DC Circuit Breaker for HVDC Systems**  
Siddavatam Ravi Prakash Reddy, Kaushik Rajashekara, Harish Sarma Krishnamoorthy  
*University of Houston, USA*
- 19C1-2 Generalized Circuit Topology and Classification of Multiline Hybrid HVDC Circuit Breakers**  
Yushi Koyama<sup>1</sup>, Shinnosuke Hamajima<sup>1</sup>, Takahiro Ishiguro<sup>2</sup>  
1) *Toshiba Infrastructure Systems & Solutions Corporation, Japan*, 2) *Toshiba Energy Systems & Solutions Corporation, Japan*
- 19C1-3 DQ Impedance Modeling and Stability Analysis of SVG with Constant Reactive Power Control**  
Yiming Tu, Tong Wu, Zeng Liu, Jinjun Liu  
*Xi'an Jiaotong University, China*
- 19C1-4 Consideration of STATCOM for Power Transmission with Dual-Redundant Controllers**  
Kohei Kobori, Takashi Sugiyama, Ryota Okuyama  
*Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan*
- 19C1-5 Comparative Evaluation of MVAC-LVDC SST and Hybrid Transformer Concepts for Future Datacenters**  
Jonas Huber<sup>1</sup>, Peter Wallmeier<sup>2</sup>, Ralf Pieper<sup>2</sup>, Frank Schafmeister<sup>3</sup>, Johann W. Kolar<sup>1</sup>  
1) *ETH Zurich, Switzerland*, 2) *Delta Energy Systems GmbH, Germany*, 3) *University of Paderborn, Germany*

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## Room D

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### Session 19D1 Multi-level Converters II

Chairs: Junnosuke Haruna (*Utsunomiya University, Japan*)

Jianwen Zhang (*Shanghai Jiao Tong University, China*)

- 19D1-1 Modulation and Analysis of Current-Fed High Gain Multilevel DC-DC Converter in BESS Charging Mode**  
Vinay Rathore, Siddavatam Ravi Prakash Reddy, Kaushik Rajashekara  
1) *University of Houston, USA*
- 19D1-2 An Improved Valve-Side Fault-Riding-Through Control Strategy For Hybrid MMC**  
Jiawei Zhang, Li Peng, Yuntao Xiao, Zhen Wang  
*Huazhong University of Science and Technology, China*
- 19D1-3 A DC Fault Ride-Through Control of Half-Bridge MMCs for the HVDC Grid with DC Circuit Breakers**  
Atsushi Chiba<sup>1</sup>, Kenichiro Sano<sup>1</sup>, Yushi Koyama<sup>2</sup>, Kei Sekiguchi<sup>2</sup>, Takahiro Ishiguro<sup>3</sup>, Daichi Suzuki<sup>3</sup>  
1) *Tokyo Institute of Technology, Japan*, 2) *Toshiba Infrastructure Systems & Solutions Corporation, Japan*, 3) *Toshiba Energy Systems & Solutions Corporation, Japan*
- 19D1-4 Commissioning test and Operation results of New Hokkaido-Honshu HVDC Link**  
Daichi Suzuki<sup>1</sup>, Noriko Kawakami<sup>2</sup>, Masanori Mori<sup>3</sup>, Takanori Uchiumi<sup>3</sup>  
1) *Toshiba Energy Systems & Solutions Corporation, Japan*, 2) *Toshiba Mitsubishi-Electric Industrial Systems Corporation, Tokyo, Japan*, 3) *Hokkaido Electric Power Network inc., Hokkaido, Japan*

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## Room E

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### Session 19E1 Wireless Power Transfer III

Chairs: Katsuhiro Hata (*The University of Tokyo, Japan*)

Ming Liu (*Shanghai Jiao Tong University, China*)

- 19E1-1 A Consideration on Efficiency Maximization for Inductive Power Transfer System with Dual Converters**  
Ryohei Okada, Ryosuke Ota, Nobukazu Hoshi  
*Tokyo University of Science, Japan*
- 19E1-2 An IPT topology with High Misalignment Tolerance and Input Impedance Angle control**  
Yijie Wang, Xilai Sun, Jianwei Mai, Liang Cai, Dianguo Xu  
*Harbin Institute of Technology, China*

- 19E1-3 Activation Function Model for Wireless Power Transfer System With an LCC-S Compensated Network**  
Shuangqing Lv, Wenjie Chen, Xiufang Hu  
*Xi'an Jiaotong University, China*
- 19E1-4 One Pulse Control of Novel Variable Active Capacitor System for Wireless Power Transfer**  
Shin-ichi Hamasaki, Keisuke Takashima, Shogo Yamashita, Tetsuji Daido  
*Nagasaki University, Japan*

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**Room F**

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**Session 19F1 Gate Drive Technology**

**Chairs:** Daiki Yamaguchi (*National Institute of Advanced Industrial Science and Technology, Japan*)  
Ravi Nath Tripathi (*Kyoto University of Advanced Science, Japan*)

- 19F1-1 Gate Drive Method Using Wireless Multiplex Transmission of Power and Signal**  
Kyungmin Sung, Yosuke Ouchi, Sogo Amagai, Kaito Sagara, Yuma Kawasaki, Hiyang Sung  
*National Institute of Technology, Japan*
- 19F1-2 An Investigation of a Power Module for Multiple Series-Connected Si-MOSFETs Realizing Voltage Balance by a Fully Digital Active Gate Control**  
Hidemine Obara<sup>1</sup>, Seiya Abe<sup>2</sup>, Keiji Wada<sup>3</sup>  
1) *Yokohama National University, Japan*, 2) *Kyushu Institute of Technology, Japan*, 3) *Tokyo Metropolitan University, Japan*
- 19F1-3 A Study on Digital Active Gate Driving of DC-DC Converter for Suppressing Switching Surge Voltage**  
Shuhei Fukunaga<sup>1</sup>, Hajime Takayama<sup>2</sup>, Takashi Hikihara<sup>2</sup>  
1) *Osaka University, Japan*, 2) *Kyoto University, Japan*
- 19F1-4 High Bandwidth Active Gate Driver for Simultaneous Reduction of Switching Surge and Switching Loss of SiC-MOSFET**  
Yuichi Noge, Masahito Shoyama  
*Kyushu University, Japan*

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**Room H**

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**Session 19H1 Control method for Automobile**

**Chairs:** Shigeyuki Takagi (*Tokyo University of Technology, Japan*)  
Nobuhisa Yamaguchi (*DENSO CORPORATION, Japan*)

- 19H1-1 Design and Control of the Adjustable Turn-ratio LLC Converter for High-Efficiency Operation of Wired/Wireless Integrated EV Charging System**  
Hyeon-Woo Jo, Dong Hyeon Sim, Ju-A Lee, Won-Jin Son, Byoung Kuk Lee  
*Sungkyunkwan University, Korea*
- 19H1-2 MPPT operation performance of automotive photovoltaic system during driving**  
Yosuke Tomita<sup>1</sup>, Masanori Saito<sup>1</sup>, Yoshiyuki Nagai<sup>1</sup>, Tsutomu Tanimoto<sup>1</sup>, Takumi Arai<sup>1</sup>, Kimihiro Nishijima<sup>2</sup>  
1) *Nissan Motor Co., Ltd. Japan*, 2) *Sojo University, Japan*
- 19H1-3 A Novel Charging Control for D-EPC with DC Power Sources Connected in Series**  
Hiromu Akiyama, Hiroki Matsuno, Kantaro Yoshimoto, Tomoki Yokoyama  
*Tokyo Denki University, Japan*
- 19H1-4 Decentralized Control Using Wireless Signal Communication for Multi-Port EV Charger with Multiple Cells**  
Keita Ohata, Hiroki Watanabe, Jun-ichi Itoh, Keisuke Kusaka  
*Nagaoka University of Technology, Japan*

Room A

**Session 19A2 Power Electronics for Future Aircraft (OS)**

**Chairs:** Koji Yamaguchi (*IHI Corporation, Japan*)

Tseng King Jet (*Singapore Institute of Technology, Singapore*)

**19A2-1 High-Density Motor Drive Development for Electric Aircraft Propulsion: Cryogenic and non-Cryo Solutions**

*Invited Paper* Fang Luo, Mustafeez-ul-Hassan, Zhao Yuan, Kushan Choksi  
*Stony Brook University, USA*

**19A2-2 Electromagnetic Design of Dual Winding Permanent Magnet Synchronous Motor for Electromechanical Actuators of Flight Control Systems**

*Invited Paper* Yutaka Terao<sup>1</sup>, Hiroshi Hirayama<sup>2</sup>, Hirotaka Sugawara<sup>3</sup>, Hitoshi Oyori<sup>3</sup>  
1) *The University of Tokyo, Japan*, 2) *Akita University, Japan*, 3) *IHI Corporation, Japan*

**19A2-3 Construction of an Electric Aircraft System Model with Power Device Losses**

*Invited Paper* Takamitsu Yamahigashi, Kensuke Shibuya, Koichi Shigematsu, Jun Imaoka, Masayoshi Yamamoto  
*Nagoya University, Japan*

**19A2-4 Wireless Charging Technologies and Standardization for Electric Unmanned Crafts**

*Invited Paper* S. Cao<sup>1</sup>, A. Nawawi<sup>2</sup>, Z. Lim<sup>2</sup>, J. Ang<sup>2</sup>, X. Hu<sup>2</sup>, C.F. Tong<sup>2</sup>, K.J. Tseng<sup>1</sup>  
1) *Singapore Institute of Technology, Singapore*, 2) *Xnergy Autonomous Power Technologies Pte. Ltd., Singapore*

Room B

**Session 19B2 Design and Control of Flux Modulation Permanent Magnet Machines (OS)**

**Chairs:** Dawei Li (*Huazhong University of Science and Technology, China*)

Yuting Gao (*Nagoya Institute of Technology, Japan*)

**19B2-1 Analysis of Double Flux Modulation Flux Reversal Machines with Different Consequent-Pole PM Topologies**

*Invited Paper* Yuting Zheng, Lijian Wu, Youtong Fang  
*Zhejiang University of Science and Technology, China*

**19B2-2 Pole-Slot Combination Design and Investigation of Spoke-Type In-Wheel Motor Considering Flux Modulation**

*Invited Paper* Zirun Lu, Zixuan Xiang, Xiaoyong Zhu, Min Jiang  
*Jiangsu University, China*

**19B2-3 A General Design Approach of Surface-Mounted Permanent Magnet Vernier Machine**

*Invited Paper* Yu Zhao, Dawei Li, Xiang Ren, Ronghai Qu  
*Huazhong University of Science and Technology, China*

**19B2-4 Investigation of Variable Field Harmonic Principle in Hybrid-Excited Switched-Flux Machine**

*Invited Paper* Hui Yang<sup>1</sup>, Yanding Bi<sup>2,1</sup>, Cheng Qian<sup>1</sup>, Dawei Li<sup>3</sup>, Heyun Lin<sup>1</sup>, Z. Q. Zhu<sup>4</sup>, Shuangxia Niu<sup>2</sup>  
1) *Southeast University, China*, 2) *The Hong Kong Polytechnic University, China*, 3) *Huazhong University of Science and Technology, China*, 4) *The University of Sheffield, UK*

Room C

**Session 19C2 Multi-level converters III**

**Chairs:** Hiroyuki Asahara (*Okayama University of Science, Japan*)

Kyo-Beum Lee (*Ajou University, Korea*)

**19C2-1 An Isolated Modular Multi-level DC Transformer with Embedded Multi-port Current Flow Controller for Meshed DC Distribution Grids**

Yuwen Liu<sup>1</sup>, Xinming Fan<sup>2</sup>, Jianqiao Zhou<sup>1</sup>, Gang Shi<sup>1</sup>, Jiacheng Wang<sup>3</sup>, Jiajie Zang<sup>3</sup>, Xu Cai<sup>1</sup>, Jianwen Zhang<sup>1</sup>  
1) *Shanghai Jiao Tong University, China*, 2) *Foshan Power Supply Bureau of Guangdong Power Grid Co., Ltd., China*, 3) *Simon Fraser University, Canada*

- 19C2-2 A Novel Multiport Modular Multilevel Converter for AC-DC Hybrid Distribution Power System**  
Yong Sun<sup>1</sup>, Yongshan Xiao<sup>2</sup>, Xinming Fan<sup>3</sup>, Jianwen Zhang<sup>1</sup>, Jianqiao Zhou<sup>1</sup>, Gang Shi<sup>1</sup>, Xu Cai<sup>1</sup>  
1) Shanghai Jiaotong University, China, 2) Ocean University of China, China, 3) Guangdong Power Grid Co.,Ltd., China
- 19C2-3 Operation of Single-Delta Bridge-Cell Converter With Single-Phase Medium-Frequency Transformer Under Low Magnetizing Inductance**  
Kento Okumura, Makoto Hagiwara  
Tokyo Institute of Technology, Japan
- 19C2-4 Cost-effective Valve Test Circuit for MMC Based HVDC Power Station**  
Chi-Hwan Bae<sup>1</sup>, Hak-Soo Kim<sup>1</sup>, Kwang-Rae Jo<sup>2</sup>, Eui-Cheol Nho<sup>1</sup>  
1) Pukyong National University, Korea, 2) Technology & Research Institute, Korea

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## Room D

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### Session 19D2 PFC Converters

**Chairs:** Kenichi Nagayoshi (*Toyota Industries Corporation, Japan*)  
Ryosuke Ota (*Tokyo University of Science, Japan*)

- 19D2-1 Individual-Phase Displacement Power Factor Control Strategy of an Active Power-Line Conditioner in Three-Phase Four-Wire Distribution Feeders**  
Yuka Sabi<sup>1</sup>, Yuya Kihara<sup>1</sup>, Hiroaki Yamada<sup>1</sup>, Toshihiko Tanaka<sup>1</sup>, Fuka Ikeda<sup>2</sup>, Masayuki Okamoto<sup>2</sup>, Seong Ryong Lee<sup>3</sup>  
1) Yamaguchi University, Japan, 2) National Institute of Technology, Japan, 3) Kunsan National University, Korea
- 19D2-2 Improvement of Characteristics in CRM-PFC Using a Control Method based on Switching Frequency Limitation**  
Ryunosuke Araumi<sup>1</sup>, Ryuji Yamada<sup>1</sup>, Keiji Wada<sup>2</sup>  
1) Fuji Electric Co., Ltd., Japan, 2) Tokyo Metropolitan University, Japan
- 19D2-3 Aggregated Modeling for Paralleled PFC Converters in Three-Phase Data Center Power Systems**  
Tianhua Zhu<sup>1</sup>, Xiongfei Wang<sup>1</sup>, Fangzhou Zhao<sup>1</sup>, Guoqing Gao<sup>1</sup>, Grover Torricco<sup>2</sup>  
1) Aalborg University, Aalborg, Denmark, 2) Huawei technologies Sweden AB, Sweden

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## Room E

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### Session 19E2 Softswitching Converters

**Chairs:** Tomokazu Mishima (*Kobe University, Japan*)  
Feng Wang (*Xi'an Jiaotong University, China*)

- 19E2-1 An Accurate Backflow Power Calculation Method for the CLLC Resonant Converter Based on FHA and Time-Domain model**  
Yichen Wang, Feng Wang, Fang Zhuo, Xiaoqing Yin, Jiachen Tian, Haoyu Wang  
Xi'an Jiaotong University, China
- 19E2-2 Light Load Efficiency Boost Technique for Switched Tank Converters Based on Hybrid ZVS-ZCS Control**  
Jiawei Liang, Haoyu Wang  
ShanghaiTech University, China
- 19E2-3 Derivation of Resonant Period for Soft Switching by Linearizing Output Capacitance of Switching Device**  
Sihoon Choi, Ayato Suzuki, Jun Imaoka, Masayoshi Yamamoto  
Nagoya University, Japan
- 19E2-4 Single-Phase PWM Control of qZSIs for Switching-Loss and Capacitor Reduction Utilizing Accurate DC-Side Current Reference**  
Tomoyuki Mannen  
University of Tsukuba, Japan

### **Session 19F2 DC-AC Converters**

**Chairs:** Kansuke Fujii (*Fuji Electric Co., Ltd., Japan*)  
Cheng Huang (*University of Tsukuba, Japan*)

- 19F2-1 Experimental Verification of Interleaved Grid-Tied Inverter Using Discontinuous Current Mode with Magnetically Coupled Inductor**  
Shuntaro Uesugi, Cheng Huang, Tomoyuki Mannen, Takanori Isobe  
*University of Tsukuba, Japan*
- 19F2-2 Current Ripple Reduction with Enhanced ZVS Operation Based on Off-time Discrete Control for DCM Inverters to Achieve High Efficiency**  
Cheng Huang, Tomoyuki Mannen, Takanori Isobe  
*University of Tsukuba, Japan*
- 19F2-3 A More Accurate ZVS Criterion for Resonant Converters**  
Chanh-Tin Truong, Sung-Jin Choi  
*University of Ulsan, Korea*
- 19F2-4 Characterization and Switching Strategy Development for SMP SiC Power Modules**  
Yu Shiogai<sup>1</sup>, Alberto Castellazzi<sup>2</sup>, Takashi Hikihara<sup>1</sup>  
1) *Kyoto University, Japan*, 2) *Kyoto University of Advanced Science, Japan*

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**Room G**

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### **Session 19G2 Motor Drive System and Control I**

**Chairs:** Yukinori Inoue (*Osaka Metropolitan University, Japan*)  
Shizunori Hamada (*Meidensha Corporation, Japan*)

- 19G2-1 High-Speed and Low-Latency Transmission by Millimeter-Wave Digital Wireless System for Si-IGBT/SiC-MOSFET Driver Control**  
Yukako Tsutsumi<sup>1</sup>, Koji Akita<sup>1</sup>, Hiroyuki Kitagawa<sup>1</sup>, Kentaro Suzuki<sup>2</sup>, Ryosuke Saito<sup>2</sup>, Yoshihiro Tawada<sup>3</sup>  
1) *Toshiba Corporation, Japan*, 2) *Toshiba Infrastructure Systems & Solutions Corporation, Japan*, 3) *Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan*
- 19G2-2 Motor Current Reconstruction Method Using Single Shunt Resistance by High-Frequency Voltage Injection**  
Takuji Mitsui, Yoshitaka Iwaji  
*Ibaraki University, Japan*
- 19G2-3 Hexagonal Voltage Modification Scheme to Improve Torque Capability of Low-Cost Drives**  
Hyung-June Cho<sup>1</sup>, Yong-Cheol Kwon<sup>2</sup>, Seung-Ki Sul<sup>1</sup>  
1) *Seoul National University, Korea*, 2) *PLECKO Co., Ltd., Korea*
- 19G2-4 Design of Predictive Controllers and Input Filters for Matrix Converter PMSM Drive Systems**  
Tian-Hua Liu, Jia-Han Li  
*National Taiwan University of Science and Technology, Taiwan*

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**Room H**

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### **Session 19H2 Converter topologies for Automobiles**

**Chairs:** Sakahisa Nagai (*The University of Tokyo, Japan*)  
Nobuhisa Yamaguchi (*DENSO CORPORATION, Japan*)

- 19H2-1 Static and Dynamic Cryogenic Characterizations of Commercial High Performance GaN HEMTs for More Electric Aircraft**  
Yuqi Wei, Md Maksudul Hossain, H. Alan Mantooth  
*University of Arkansas, USA*
- 19H2-2 A New Family of Non-Isolated Single-Inductor Three-Port Converter Based on A Storage Port Switch-Commutated Unit**  
Chengdong Yin, Hong Li, Yamin Li, Wenzhe Su, Trillion Q. Zheng  
*Beijing Jiaotong University, China*

**19H2-3 Analysis and Theoretical Comparison of 1-to-1.5 Resonant Switched Capacitor Converters for High-Voltage EV Batteries**

Masatoshi Uno, Toko Sanada, Yuto Fujii  
*Ibaraki University, Japan*

**19H2-4 Analysis and Conceptualization of a 800V 100 kVA Full-GaN Three-Level Flying Capacitor Inverter for Next-Generation Electric Vehicle Drives**

Davide Cittanti, Enrico Vico, Eric Armando, Radu Bojoi  
*Politecnico di Torino, Italy*

**Thursday, May 19: 14:05-15:45**

**Room A**

**Session 19A3 Power Electronics for Renewable Energy Interconnected Grid (OS)**

**Chairs:** Naomitsu Urasaki (*University of the Ryukyus, Japan*)

Sjur Føyen (*Norwegian University of Science and Technology, Norway*)

**19A3-1 Analysis of Power Electronics-Dominated Hybrid AC/DC Grid for Data-Driven Oscillation Diagnosis**

*Invited Paper* Haoxiang Zong<sup>1</sup>, Chen Zhang<sup>1</sup>, Xu Cai<sup>1</sup>, Marta Molinas<sup>2</sup>  
1) *Shanghai Jiao Tong University, China*, 2) *Norwegian University of Science and Technology, Norway*

**19A3-2 Modeling and Calculation of Grid Frequency Support Effect and Transient Energy Demand of a Virtual Synchronous Generator**

*Invited Paper* Jia Liu, Jinjun Liu  
*Xi'an Jiaotong University, China*

**19A3-3 A High Side Voltage Fluctuation Suppression Control of Bidirectional Chopper to Reduce Capacitance of DC Bus**

*Invited Paper* Hiroaki Kakigano  
*Ritsumeikan University, Japan*

**19A3-4 Application of Reinforcement Learning Algorithm to Parameter Identification for MPPT Control of PMSG Wind Energy Conversion Systems**

*Invited Paper* Ryo Miyara<sup>1</sup>, Jargalsaikhan Nyam<sup>1</sup>, Takeyoshi Kato<sup>2</sup>, Natarajan Prabakaran<sup>3</sup>, Hitoshi Takahashi<sup>4</sup>, Tomonobu Senjyu<sup>1</sup>  
1) *University of the Ryukyus, Japan*, 2) *Nagoya University, Japan*, 3) *SASTRA Deemed University, India*, 4) *Fuji Electric Co., Ltd., Japan*

**Room B**

**Session 19B3 Energy Storage Systems**

**Chairs:** Yushi Miura (*Nagaoka University of Technology, Japan*)

Giuseppe Guidi (*Sintef Energy Research, Norway*)

**19B3-1 Autonomous Control for Cooperative Operation between Energy Storage Systems**

Tomohiro Yamaguchi, Takayuki Matsumoto  
*GS Yuasa Infrastructure Systems Co., Ltd., Japan*

**19B3-2 Design of Integral Droop Control for Hybrid Energy Storage System Considering Ramp Rate Characteristic**

Seung-Hyun Choi<sup>1</sup>, Jae-Sang Kim<sup>1</sup>, Jeong-Eon Park<sup>1,2</sup>, Donghyeon Yu<sup>1</sup>, Gun-Woo Moon<sup>1</sup>  
1) *Korea Advanced Institute of Science and Technology (KAIST), Korea*, 2) *Korea Aerospace Research Institute (KARI), Korea*

**19B3-3 New Circuit Structure Applying MMC and Its Control for Quick Charger System**

Shin-ichi Hamasaki, Konosuke Takahashi, Yuga Fujita, Tetsuji Daido  
*Nagasaki University, Japan*

**19B3-4 Efficiency Characteristic of a High-Power Reconfigurable Battery with Series-Connected Topology**

Jan Engelhardt, Jan Martin Zepter, Tatiana Gabderakhmanova, Mattia Marinelli  
*Technical University of Denmark, Denmark*

### **Session 19C3 Multi-level Converters IV**

**Chairs:** Kazuto Takagi (*GS Yuasa Infrastructure Systems Co., Ltd., Japan*)  
Jianqiao Zhou (*Shanghai Jiao Tong University, China*)

- 19C3-1 Design Considerations for the Intermediate Circuit of a Multimegawatt Medium-Voltage Neutral-Point-Clamped Inverter**  
Aleksi Mattsson<sup>1</sup>, Juhamatti Korhonen<sup>1</sup>, Pasi Nuutinen<sup>1</sup>, Pasi Peltoniemi<sup>1</sup>, Olli Pyrhönen<sup>1</sup>, Pertti Silventoinen<sup>1</sup>, Riku Pöllänen<sup>2</sup>  
1) *LUT University, Finland*, 2) *The Switch Drive Systems Oy, Finland*
- 19C3-2 A Fast Neutral-Point Potential Balance Modulation Method for T-type Three-Level Inverter**  
Sizheng Wang, Hui Wang  
*Central South University, China*
- 19C3-3 Simplified Finite Set Model Predictive Control for T-type Three-Level Battery Energy Storage Power Conversion System**  
Huaiyu Fan, Ning Gao, Weimin Wu  
*Shanghai Maritime University, China*
- 19C3-4 Passivity-Based Design for High-Order Harmonic Voltage Emulation of Grid Emulators**  
Zejie Li, Fangzhou Zhao, Xiongfei Wang  
*Aalborg University, Denmark*

### **Session 19D3 Control and Analysis of Converters III**

**Chairs:** Hiroki Ishikawa (*Gifu University, Japan*)  
Younghoon Cho (*Konkuk University, Korea*)

- 19D3-1 Current Balancing of Interleaved Boost PFC Converter with Auxiliary Winding Coupled Inductor**  
Dongkwan Yoon, Sungmin Lee, Jaehyeon Bang, Younghoon Cho  
*Konkuk University, Korea*
- 19D3-2 Online Optimization of Zero-Sequence Voltage Injection of PWM Strategy for 3L-NPC converters**  
Mateja Novak, Ariya Sangwongwanich, Frede Blaabjerg  
*Aalborg University, Denmark*
- 19D3-3 Submodule Capacitor Sizing for Cascaded H-Bridge STATCOM with Sum of Squares Formulation**  
Hengyi Wang<sup>1</sup>, Fei Wang<sup>1</sup>, Fei Gao<sup>2</sup>, Jianqiang Cheng<sup>3</sup>  
1) *University of Shanghai, China*, 2) *Ministry of Education, China*, 3) *The University of Arizona, USA*
- 19D3-4 Voltage Balancing Control for Y-Connected Modular Converter in MV Drive Application**  
DongUk Kim<sup>1</sup>, Sungmin Kim<sup>1</sup>  
*Hanyang University, Korea*

### **Session 19E3 Simulation of Power Electronics Systems**

**Chairs:** Kazuhiro Umetani (*Okayama University, Japan*)  
Jinjun Liu (*Xi'an Jiaotong University, China*)

- 19E3-1 Frequency-dependent Equivalent Circuit Parameter Calculation of Gapped Multiwinding Inductors**  
Thomas Ewald, Richard Schlesinger, Jan P. Agner, Jürgen Biela  
*ETH Zurich, Switzerland*
- 19E3-2 Model Extraction for Power Electronics Systems Using Vector Fitting Based on Sampling Optimized Method**  
Zipeng Liu, Jinjun Liu, Zeng Liu  
*Xi'an Jiaotong University, China*
- 19E3-3 Unification of SISO Open-loop Gain Based Stability Analysis Methods for Three-phase Cascaded System**  
Tong Wu<sup>1</sup>, Jinjun Liu<sup>1</sup>, Yiming Tu<sup>1</sup>, Zeng Liu<sup>1</sup>, Teng Liu<sup>2</sup>  
1) *Xi'an Jiaotong University, China*, 2) *Aalborg University, Denmark*

**19E3-4 Multi-objective Optimization for Dual Active Bridge Converter Based on Genetic Algorithm**

Lingfeng Jiang, Linxiao Gong, Xinyu Jin, Zhichong Shao, Wang Yong  
*Shanghai Jiao Tong University, China*

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**Room F**

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**Session 19F3 Control and Analysis of DC-DC Converters**

**Chairs:** Kazunori Hasegawa (*Kyushu Institute of Technology, Japan*)

Jaydeep Saha (*National University of Singapore, Singapore*)

**19F3-1 Effect of Parasitic Components on Dynamic Response in Buck Converters**

Hanhim Sung, Donghan Seo, Dongwook Kim, Jong-Won Shin  
*Chung-Ang University, Korea*

**19F3-2 Transient Performance Improvement of Digital Average Current Controlled Multiphase Interleaved Buck Converter**

Guihua Mao<sup>1</sup>, Guohua Zhou<sup>1</sup>, Klaus Moth<sup>2</sup>, Yashank Bansal<sup>3</sup>, Yuan Gao<sup>3</sup>, Stig Munk-Nielsen<sup>3</sup>  
1) *Southwest Jiaotong University, China*, 2) *LivingPower company, Denmark*, 3) *Aalborg University, Denmark*

**19F3-3 Burst Control Incorporated in Switching Period for Bidirectional Series Resonant Converter Achieving Small Voltage Ripple and Fully Soft Switching**

Zhijian Fang<sup>1,2,3</sup>, Yuangeng Xia<sup>1,2,3</sup>, Fei Xie<sup>1,2,3</sup>, Hanlin Dong<sup>1,2,3</sup>, Zhiguo Wei<sup>1,2,3</sup>  
1) *China University of Geosciences, China*, 2) *Hubei Key Laboratory of Advanced Control and Intelligent Automation for Complex Systems, China*, 3) *Ministry of Education, China*

**19F3-4 Comparative Overview of Power Balance Control for Two-stage and Single-stage Isolated MVAC-LVDC Cascaded Converters**

Jaydeep Saha<sup>1</sup>, Naga Brahmendra Yadav Gorla<sup>2</sup>, Sanjib Kumar Panda<sup>2</sup>  
1) *National University of Singapore, Singapore*, 2) *Nanyang Technological University, Singapore*

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**Room G**

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**Session 19G3 Motor Drive System and Control II**

**Chairs:** Masahiro Aoyama (*Shizuoka University, Japan*)

Yuichi Yokoi (*Nagasaki University, Japan*)

**19G3-1 Decoupling Control Method in an M- and T-axis Current Vector Control System of a Permanent Magnet Synchronous Motor**

Daiki Sekiguchi<sup>1</sup>, Yukinori Inoue<sup>2</sup>, Shigeo Morimoto<sup>2</sup>, Masayuki Sanada<sup>2</sup>  
1) *Osaka Prefecture University, Japan*, 2) *Osaka Metropolitan University, Japan*

**19G3-2 Online Deadbeat Predictive Direct Torque and Active Flux Control for IPMSM Drive**

S M Showybul Islam Shakib, Dan Xiao, Rukmi Dutta, Muhammed Fazlur Rahman  
*University of New South Wales, Australia*

**19G3-3 Voltage Compensation Performance of the Voltage Unbalance Compensator Using the Method of Symmetrical Components**

Tomoya Katsuki, Iori Yamakawa, Akihiro Imakiire, Satoshi Matsumoto  
*Kyushu Institute of Technology, Japan*

**19G3-4 Voltage-Integral-based Reference Tracking Modulation Method for High-Efficiency Motor Drive**

Yuto Kobayashi<sup>1</sup>, Kiyoshi Ohishi<sup>1</sup>, Yuki Yokokura<sup>1</sup>, Tenjiro Hiwatari<sup>2</sup>, Akira Satake<sup>2</sup>  
1) *Nagaoka University of Technology, Japan*, 2) *Mitsubishi Electric Corporation, Japan*

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**Room H**

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**Session 19H3 Detection, estimation, and diagnosis in rotating machines**

**Chairs:** Kenji Nakamura (*Tohoku University, Japan*)

Lew Andrew R. Tria (*University of the Philippines Diliman, Philippines*)

**19H3-1 Torque Estimation of a Variable Speed Induction Motor without Torque and Rotational Speed Meters**

Shu Yamamoto<sup>1</sup>, Hideaki Hirahara<sup>1</sup>, Masayuki Motosugi<sup>1,2</sup>  
1) *Polytechnic University, Tokyo, Japan*, 2) *Polytechnic Center Kochi, Japan*

- 19H3-2 Real-time Dynamic Eccentricity Detection by Analyzing Harmonic Components of No-load Line-line Voltages on Multi-three-phase PMSMs**  
Kodai Okazaki<sup>1</sup>, Kan Yang<sup>2</sup>, Kan Akatsu<sup>2</sup>  
1) Mitsubishi Electric Corporation, Japan, 2) Yokohama National University, Japan
- 19H3-3 TFFC-RNN:A New RNN Based Approach for Bearing and Misalignment Compound Fault**  
Ziran Guo, Ming Yang  
Harbin Institute of Technology, China
- 19H3-4 Light-Weight and Compact Magnetic Rotation Angle Sensor with Partial Arc Stator Using Three Hall-Effect Sensors**  
Tatsuo Nishimura, Koji Nishizawa, Yoshihiro Miyama, Hideaki Arita  
Mitsubishi Electric Corporation, Japan

**Thursday, May 19: 16:05-18:10**

**Room A**

**Session 19A4 Electromagnetic Compatibility (OS)**

**Chairs:** Hideki Ayano (*National Institute of Technology, Japan*)  
Wilmar Martinez (*KU Leuven, Belgium*)

- 19A4-1 EMC implications of implementing WBG devices in battery charger modules for electric vehicles**  
*Invited Paper* Wilmar Martinez, WeiRen Lin, Camilo Suarez  
*KU Leuven-EnergyVille, Belgium*
- 19A4-2 Impedance Analysis of Single-Phase PFC Converter in the Frequency Range of 0-150 kHz**  
*Invited Paper* Pooya Davari, Frede Blaabjerg  
*Aalborg University, Denmark*
- 19A4-3 Reduction of Input- and Output-Side Common-Mode Currents Based on a Coupled Common-Mode Inductor in DC-Fed Three-Phase Motor Drive Systems**  
*Invited Paper* Shotaro Takahashi, Sari Maekawa  
*Seikei University, Japan*
- 19A4-4 EMI model of Air-conditioning Outdoor Machines**  
*Invited Paper* Fan Peng, Changsheng Hu, Dehong Xu, Hui Wang, Wenxing Zhong  
*Zhejiang University, China*
- 19A4-5 Prediction of Disturbance Current from Railway Traction Inverters at Train's Maximum Design Speed**  
*Invited Paper* Satoru Hatukade  
*Railway Technical Research Institute, Japan*

**Room B**

**Session 19B4 Reliability and Diagnostics of Power Converters II**

**Chairs:** Ryota Kondo (*Mitsubishi Electric Corporation, Japan*)  
Spasoje Miric (*ETH Zurich, Switzerland*)

- 19B4-1 Reliability Modeling and Assessment of De-rated Redundant Power Converters**  
Saeed Peyghami<sup>1</sup>, Mostafa Abarzadeh<sup>2</sup>, Frede Blaabjerg<sup>1</sup>  
1) Aalborg University, Denmark, 2) SmartD Technologies Inc., Canada
- 19B4-2 A Stress Emulation Method for Concurrent Testing of AC and DC Capacitors**  
Bo Yao, Xing Wei, Haoran Wang, Huai Wang  
*Aalborg University, Denmark*
- 19B4-3 Condition Monitoring of a DC-Link Capacitor Used in a PWM Inverter With a Six-Pulse Diode Rectifier Without Current Sensors**  
Kazunori Hasegawa, Tsukasa Kubo, Yuto Hirose  
*Kyushu Institute of Technology, Japan*

**19B4-4 Local Heat Generation Analysis Method of Ferrite Cores for Wireless Power Transfer Coil Considering Compressive Stress**

Norihito Kimura<sup>1</sup>, Hiroaki Yuasa<sup>2</sup>

1) SOKEN, INC., Japan, 2) TOYOTA MOTOR CORPORATION, Japan

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**Room C**

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**Session 19C4 Advanced magnetics**

**Chairs:** Tsuyoshi Funaki (*Osaka University, Japan*)

Alberto Castellazzi (*Kyoto University of Advanced Science, Japan*)

**19C4-1 Basic Characteristics of Thin-Film Single-Layer Coreless Micro-Transformers for Digital Isolators**

Motochika Inohara, Satoshi Sugahara

*Fukuyama University, Japan*

**19C4-2 An Adaptive Active Inductor for the AC Filter of Grid-connected Drive**

Feng Liu<sup>1</sup>, Guorong Zhu<sup>1</sup>, Zhe Kong<sup>1</sup>, Haoran Wang<sup>2</sup>, Huai Wang<sup>3</sup>

1) Wuhan University of Technology, China, 2) Three Gorges Intelligent Industrial Control Technology Co.Ltd, China, 3) Aalborg University, Denmark

**19C4-3 Iron Loss Properties of Amorphous Ring under High-Frequency SiC Inverter Excitation with Different Dead-times Using High Sampling Rate**

Nguyen Gia Minh Thao<sup>1</sup>, Keisuke Fujisaki<sup>1</sup>, Duc-Kien Ngo<sup>2</sup>, Kenya Naruse<sup>1</sup>

1) Toyota Technological Institute, Japan, 2) The University of Danang–University of Technology and Education, Vietnam

**19C4-4 An Integrated Matrix Magnetics for Isolated Single-stage DC/DC Converter**

Fei Li, Laili Wang, Longyang Yu

*Xi'an Jiaotong University, China*

**19C4-5 A Load Test Method Using Two Power Supplies for High-Frequency Transformers**

Koji Orikawa, Shogo Nishikawa, Satoshi Ogasawara

*Hokkaido University, Japan*

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**Room D**

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**Session 19D4 SiC Device Applications**

**Chairs:** Takeshi Horiguchi (*Mitsubishi Electric Corporation, Japan*)

Yanbo Wang (*Aalborg University, Denmark*)

**19D4-1 Verification and Application of an Analytical Switching Loss Model for a SiC MOSFET and Schottky Diode Half-Bridge**

Anliang Hu, Jürgen Biela

*ETH Zurich, Switzerland*

**19D4-2 Experimental Verification of a Gate-Drive Circuit Using Distributed Signal Processing for Fast-Switching Operation of SiC MOSFETs**

Daiki Yamaguchi, Shinji Sato, Atsushi Yao, Hiroshi Sato

*National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan*

**19D4-3 Real-time FPGA Simulation of Dual Active Bridge Converter with SiC MOSFET Device Model**

Gard Lyng Rodal, Dimosthenis Pefitsis

*Norwegian University of Science and Technology, Norway*

**19D4-4 Low Inductive Platform for Long- and Short-term Dynamic Characterization of SiC MOSFETs**

Daniel A. Philipps, Tobias N. Ubostad, Dimosthenis Pefitsis

*Norwegian University of Science and Technology, Norway*

### **Session 19E4 DC-DC Converters IV**

**Chairs:** Yoshiya Ohnuma (*Nagaoka Power Electronics co., Ltd., Japan*)

Qinglei Bu (*Xi'an Jiaotong-Liverpool University, China*)

- 19E4-1 99%, 15 W/cm<sup>3</sup> capacitively coupled modular DCPET for low-voltage dc power supply system**  
Keigo Arita, Yusuke Hayashi, Kazuto Takao  
*Toshiba Corporation, Japan*
- 19E4-2 A Hybrid Step-up DC-DC Converter based on Ladder Switched-capacitor and High-frequency Transformer**  
Qinqin Dong<sup>1</sup>, Yu Fu<sup>1</sup>, Shanwei Liu<sup>1</sup>, Shouxiang Li<sup>1</sup>, Guoju zhang<sup>2</sup>  
1) *Beijing Institute of Technology, China*, 2) *Chinese Academy of Sciences, China*
- 19E4-3 A Family of High Step-up Isolated DC-DC Converters based on Fibonacci Switched-capacitor Cell**  
Shanwei Liu<sup>1</sup>, Qinqin Dong<sup>1</sup>, Yu Fu<sup>1</sup>, Shouxiang Li<sup>1</sup>, Guoju Zhang<sup>2</sup>  
1) *Beijing Institute of Technology, China*, 2) *Chinese Academy of Sciences, China*
- 19E4-4 Transient Bias Suppression Optimization for Bidirectional 2/3-Level DC-DC Converters**  
Qinglei Bu<sup>1,2</sup>, Huiqing Wen<sup>1</sup>, Yinxiao Zhu<sup>1,2</sup>, Haochen Shi<sup>3</sup>, Guanying Chu<sup>1</sup>  
1) *Xi'an Jiaotong-Liverpool University, China*, 2) *University of Liverpool, UK*, 3) *Huazhong University of Science and Technology, China*
- 19E4-5 Analysis and Improvement of Harmonic Content in Multi-level Three-phase DAB Converters with Different Transformer Windings Connections**  
Babak Khanzadeh, Torbjörn Thiringer, Yuriy Serdyuk  
*Chalmers University of Technology, Sweden*

### **Session 19F4 Multi-level Converters V**

**Chairs:** Hiroaki Yamada (*Yamaguchi University, Japan*)

Kenichiro Sano (*Tokyo Institute of Technology, Japan*)

- 19F4-1 A Multiple-AC-Ports Power Electronic Transformer**  
Xinyi Kong<sup>1</sup>, Xinming Fan<sup>2</sup>, Jianqiao Zhou<sup>1</sup>, Gang Shi<sup>1</sup>, Jiajie Zang<sup>1</sup>, Jiacheng Wang<sup>1</sup>, Xu Cai<sup>1</sup>, Jianwen Zhang<sup>1</sup>  
1) *Shanghai Jiaotong University, China*, 2) *Foshan Power Supply Bureau of Guangdong Power Grid Co., Ltd., China*
- 19F4-2 A 1200V DC-link Hybrid Si/SiC Four-level ANPC Inverter with Balanced Loss Distribution, dv/dt and Cost**  
Jun Wang, Lihong Xie, Xibo Yuan, Wenzhi Zhou, Ian Laird  
*University of Bristol, UK*
- 19F4-3 Efficiency Improvement of Flying-Capacitor Linear Amplifier by Unequal Capacitor Voltage Ratio**  
Hidemine Obara, Keiichi Matsushima  
*Yokohama National University, Japan*
- 19F4-4 DC Power Filter Design for a Neutral-Point Clamped Hybrid Multilevel Converter**  
Caspar T. Collins, Tim C. Green  
*Imperial College London, UK*

### **Session 19G4 Reluctance Motor Drives**

**Chairs:** Kohei Aiso (*Shibaura Institute of Technology, Japan*)

Tetsuya Kojima (*Mitsubishi Electric, Japan*)

- 19G4-1 Effect of Inductance Model on Sensorless Control Performance of SynRM with Magnetic Saturation**  
Yuma Tsujii<sup>1</sup>, Shigeo Morimoto<sup>2</sup>, Yukinori Inoue<sup>2</sup>, Masayuki Sanada<sup>2</sup>  
1) *Osaka Prefecture University, Japan*, 2) *Osaka Metropolitan University, Japan*
- 19G4-2 Standstill Sensorless Self-Commissioning Strategy of Synchronous Machine Considering Rotor Rotation Reduction Technique**  
Hyun-Jun Lee, Je-Eok Joo, Young-Doo Yoon  
*Hanyang University, Korea*

- 19G4-3 Improved Parameter Estimation Method for Flux Saturation Model of Synchronous Reluctance Machines**  
Tae-Gyeom Woo, Hyun-Jun Lee, Young-Doo Yoon  
*Hanyang University, Korea*
- 19G4-4 Proposal of Optimal Design Method for Capacitance in Operating Area Expandable SR Motor Drive Circuit**  
Taisei Kurishima, Ryuya Sugai, Hiroki Goto, Hirohito Funato, Junnosuke Haruna  
*Utsunomiya University, Japan*
- 19G4-5 An Open-Loop Control for the Determination of the MTPV-Trajectory of a SynRM**  
Vasken Ketchedjian, André Haspel, Jörg Haarer, Jörg Roth-Stielow  
*University of Stuttgart, Germany*

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**Room H**

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**Session 19H4 Motor analysis**

**Chairs:** Masafumi Fujita (*Toshiba Energy Systems & Solutions Corporation, Japan*)  
Masatsugu Nakano (*Mitsubishi Electric Corporation, Japan*)

- 19H4-1 Analytical Approach to Estimate Torque Characterization of Synchronous Motors Assisted by FEA**  
Zheng-Feng Li, Ming-Shi Huang, Lin-Wei Huang  
*National Taipei University of Technology, Taiwan*
- 19H4-2 Cost-efficient Analysis of Core and PM Eddy Current Loss Considering Current Harmonics**  
Jun-Yeol Ryu, Jun-Woo Chin, Myung-Seop Lim  
*Hanyang University, Korea*
- 19H4-3 Efficient Frequency-domain Evaluation of Transient Voltage Effects in Electric Machines**  
Bianca Wex<sup>1</sup>, Siegfried Silber<sup>1</sup>, Petra Miletic<sup>2</sup>, Wolfgang Gruber<sup>3</sup>  
*1) Linz Center of Mechatronics, Austria, 2) University of Rijeka, Croatia, 3) Johannes Kepler University, Austria*
- 19H4-4 Analysis of Winding AC Loss in a Permanent Magnet Synchronous Machine With High Slot Fill Aluminum Winding**  
Hiroya Sugimoto<sup>1</sup>, Yuto Yamada<sup>1</sup>, Kazuhito Imae<sup>2</sup>  
*1) Tokyo Denki University, Japan, 2) Aster Co., Ltd., Japan*
- 19H4-5 Learning Thermal Properties and Temperature Models of Electric Motors with Neural Ordinary Differential Equations**  
Wilhelm Kirchgässner, Oliver Wallscheid, Joachim Böcker  
*Paderborn University, Germany*