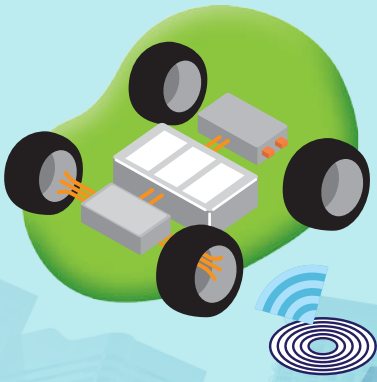
Program & Abstracts

Technologies for Future Mobility by xEV



EVTeC2025

THE 7TH INTERNATIONAL ELECTRIC VEHICLE TECHNOLOGY CONFERENCE

MAY 19-21 2025

PACIFICO YOKOHAMA, JAPAN

Organized by Society of Automotive Engineers of Japan, Inc. (JSAE)

https://evtec.jsae.or.jp/2025/

Sponsors

We express our sincere thanks to our sponsors!

GOLD

TOYOTA

SUBARU

HONDA

NISSAN MOTOR CORPORATION

Silver

DENSO

Bronze

JARI

Astemo Mobility Beyond

MEIDEN Quality connecting the next

Supporter

Technical Support Mechatronics and Measuring instruments

YAMADA

ISUZU

HINO

ROHDE & SCHWARZ

Contents

Welcome Remarks

Kan AKATSU

Yokohama National University
Chairperson of EVTeC2025

“Technologies for Future Mobility by xEV”

Welcome to EVTeC 2025 in Yokohama, Japan.

On behalf of the organizing committee of EVTeC 2025, organized by JSAE, we warmly welcome all of you to the conference and to the beautiful city of Yokohama. We also extend our sincere gratitude to all our sponsors for their generous support of the event.

The first EVTeC was held in May 2011 with great success. Since then, it has taken place in 2014, 2016, 2018, and 2021-making EVTeC 2025 the sixth installment. Fourteen years have passed since the inaugural event, and during that time, the environment surrounding electric vehicles has changed significantly. In recent years, it is fair to say that electric vehicles have faced headwinds, influenced heavily by rapidly shifting economic and political landscapes. However, the progression of global warming is undeniable, and we believe it is our responsibility to provide environmentally friendly automobiles regardless of economic circumstances.

We must continue our research and development, constantly striving for the technological innovations necessary to meet this goal. If I may add, it is precisely during challenging times like these that we must develop and accumulate knowledge, refine our technologies, and prepare for the opportunities that lie ahead.

The theme of EVTeC 2025 is “Technologies for Future Mobility by xEV”. This represents our motivation to discuss not only EVs, but all environmentally friendly automobile technologies such as HEVs, PHEVs, and FCVs. In the Plenary Session and Keynote Session, there will be messages from the heads of Japanese OEMs and research presentations from experts in various fields. This time, we will focus not only on electrification technology but also on ICE technology. Approximately 100 cutting-edge technologies will be presented in the general sessions. We encourage you to join the sessions, engage in discussions, and explore the future of xEVs together.

Finally, Yokohama is a city full of sights to see and delicious food to enjoy, both day and night. After the engaging discussions, we hope you’ll take the time to explore the city and indulge your senses and treat your eyes and your appetite to all that Yokohama has to offer.

Please enjoy EVTeC 2025 in Yokohama!

Committees

International Advisory Committee

Chair:
Yoichi HORI (Tokyo University of Science)
Vice chair:
Hiroshi FUilMOTO (The University of Tokyo)
Keiichiro KONDO (Waseda University)
Members:
Seungyoung AHN (KAIST (Korea Advanced Institute of Science and Technology))
Takafumi ANEGAWA (CHAdeMO Association)
Carla BAILO (SAE International)
Yuwu FU (China Society of Automotive Engineers (China SAE))
Akihiro IIYAMA (Hydrogen and Fuel Cell Nanomaterials Center/University of Yamanashi)
Valentin IVANOV (Smart Vehicle Systems, Technical University ofllmenau, Germany)
Minoru KAMATA (Japan Automobile Research Institute)
Ryoji KANNO (Institute of Science Tokyo)
Guibin LIU (China Automotive Technology and Research Center Co., Ltd.)
Chris MI (San Diego State University)
Kunio NAKAGURO (Nissan Motor Co., Ltd./Society of Automotive Engineers of Japan)
Chun T. RIM (Gwangju Institute of Science and Technology)
Mi-Ching TSAI (National Cheng Kung University)
Xuhui WEN (Chinese Academy of Sciences)
Dianguo XU (Harbin Institute of Technology)
ZI-Qiang ZHU (University of Sheffield, UK)

Steering Committee

Chairperson:
Kan AKATSU (Yokohama National University)
Vice Chairperson:
Takehiro IMURA(Tokyo University of Science)
Toshifumi TAKAOKA(TOYOTA MOTOR CORPORATION)
Atsuharu OTA (TOYOTA MOTOR CORPORATION)
Chair of Program Committee:
Hiroya SUGIMOTO (Tokyo Denki University)
Vice-Chair of Program Committee:
Katsuhiro HATA (Shibaura Institute of Technology)
Kenji NATORI (Chiba University)
Osamu SHIMIZU (The University of Tokyo)
Member:
Kohei AISO (Shibaura Institute of Technology)
Ryosuke AKAKI (Suzuki Motor Corporation)
Yoshitaka ASAKURA (KABUSHIKIKAISHA AYE)
Pedram ASEF (University College London)
Kenta EMORI (Nissan Motor Co., Ltd.)
Tomohiro FUKAZU (Honda R&D Co., Ltd.)
Giuseppe GUIDI (Sintef Energy)
Satoru HIRANO (Hino Motors, Ltd.)
Kotaro IKEDA (TOYOTA MOTOR CORPORATION)
Daichi IMAMURA (Japan Automobile Research Institute (JARI))
Junichi ITOH (Nagaoka University of Technology)
Takeshi KATO (Honda R&D Co., Ltd.)
Keisuke KUSAKA (Nagaoka University of Technology)
Takashi MAJIMA (IHI Inspection & Instrumentation Co., Ltd.)
Shohji TSUSHIMA (Osaka University)
Yoshinori YAMAMOTO (MITSUBISHI MOTORS CORPORATION)
Satoshi YASUDA (TOYOTA MOTOR CORPORATION)
Yukio YOKOI (Takushoku University)
Noriko YOSHIZAWA (National Institute of Advanced Industrial Science and Technology)
Makoto UCHIDA (University of Yamanashi)
Kenichiro UEDA (Honda R&D Co., Ltd.)

Supporting Organizations

Endorsed by

FISITA (International Federation of Automotive Engineering Societies)

In Association with

Battery Association of Japan (BAJ, Japan)
The Electrochemical Society of Japan (ECSJ, Japan)
Fuel Cell Development Information Center (FCDIC, Japan)
Hydrogen Energy Systems Society of Japan (HESS, Japan)
The Institute of Electrical Engineers of Japan (IEEJ, Japan)
The Institute of Electronics, Information and Communication Engineers (IEICE, Japan)
Japan Automobile Manufacturers Association (JAMA, Japan)
Japan Auto Parts Industries Association (JAPIA, Japan)
Japan Automobile Research Institute (JARI, Japan)
Japan Electronics and Information Technology Industries Association (JEITA, Japan)
The Japan Institute of Power Electronics (JIPE, Japan)
The Japanese Society for Artificial Intelligence (JSAI, Japan)
The Japan Society of Mechanical Engineers (JSME, Japan)
The Society of Instrument and Control Engineers (SICE, Japan)
Japan Electric Vehicle Club (Japan)
Capacitors Forum (Japan)
SAE International (USA)
China Automotive Technology and Research Center (CATARC,China)
The Korean Society of Automotive Engineers(KSAE,Korea)
World Electric Vehicle Association (WEVA)

General Information

Event
The 7th International Electric Vehicle Technology Conference (EVTeC2025)

Date
May 19-21 2025

Venue
Conference Center
PACIFICO YOKOHAMA, JAPAN (In-person format)

Check-in Desk
Monday, May 19	8:30-17:00
Tuesday, May 20	8:30-17:00
Wednesday, May 21	8:30-17:00

Official Language
English

Badge
All participants are kindly requested to wear their badges during the conference.

Coffee Break
Coffee and refreshments will be available during the conference, just outside the Plenary Room.

Internet Access (within the conference venue)
SSID: EVTeC2025
PW: yokohama_ev2025

Certificate of Attendance
We will provide you the certificate of attendance after the conference for all the attendees onsite.

Lost and Found
Inquiries regarding lost and found articles can be made at the registration desk.

Cloakroom
Please drop off your baggage at the cloakroom next to the registration desk. We opens from 8:30 to 18:00 (18:30 on May 21).

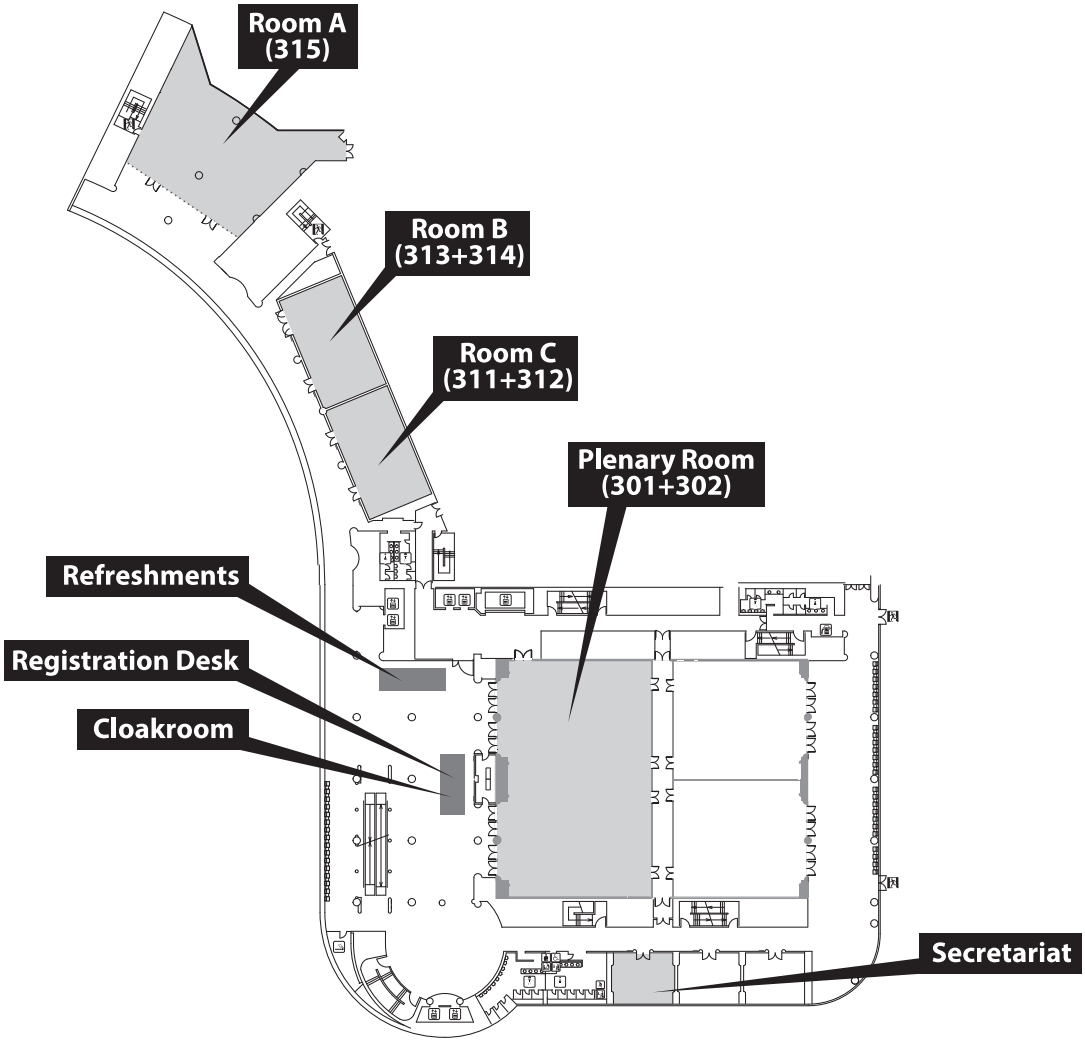
Photography and Recording
All attendees except an official photographer are NOT allowed to record, take photos or screenshots of any live presentation. The official photographer will be present at the venue to take pictures for recording purposes. Please note that the pictures will be published at the website and used for other communications activities after the event.

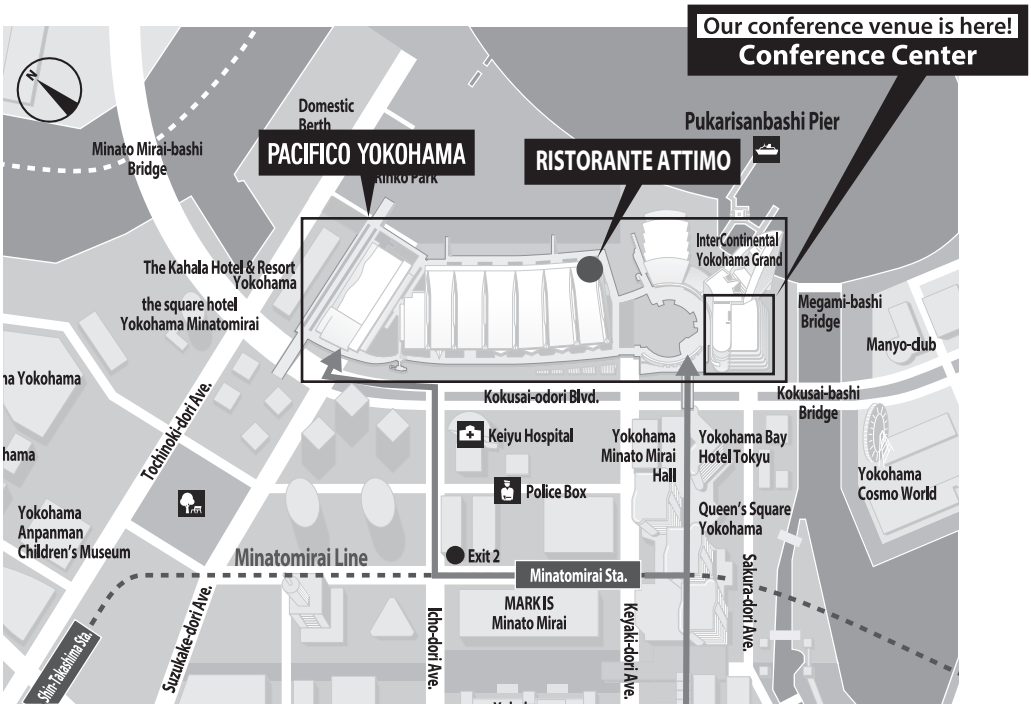
Reception Party (pre-booked only)
Date & Time: 18:10-20:00, Tuesday, May 20, 2025
Place: Ristorante ATTIMO (on the ocean side of the Exhibition Hall 2F) *see the next page

Awards & Closing Ceremony
The events will be held at Room A in May 21, 2025. Winners should be announced during the ceremony.

Map

Conference venue: Pacifico Yokohama Conference Center (3rd Floor)





Instructions for Presenters

Presentation time

20 min total (15 min for presentation, 5 min for discussion)

15 minutes prior to your session (during coffee break)	Please arrive at your session room **15 minutes** before the session begins (during the break) and bring your laptop with you.
	When you arrive at the session room, please contact staff in the room and review your slides on the screen. Our staff will connect your laptop (HDMI port required) to the selector so that your presentation can be displayed on it sooner. In your turn, please place your laptop on the podium and start your presentation. If your laptop is not allowed to connect to the selector, please hand over your USB flash drive including your slides to the desk. "Presenter tools" of Windows or "Keynote" of Mac can be used.
Session Starts	Have a seat in the "Next Presenters' seat"
Your presentation	Move and bring your laptop to the podium and start your presentation. For timekeeping, staff will ring a bell as below: 1st bell: 12 mins after you start a presentation 2nd bell: 15 mins (End of the presentation) *move to a discussion 3rd bell: 20 mins passed (end of your slot)
Discussion	A chair opens the floor.
End	The chair closes your presentation and return back to your seat.

In the case of no-show

If you are a no-show and don't give a presentation during the session, we cannot issue the Certificate of Presentation to you. A pre-recorded presentation video cannot be acceptable.

The Young Investigator Awards

The award ceremony will be held at the closing ceremony on May 21. The winners will be contacted by the secretariat before the ceremony by email or will be announced on the information board near the check-in desk during the conference.

Time Table

<table>
<tr><th>Date</th><th colspan="3">DAY 1 May 19 MONDAY</th><th colspan="3">DAY 2 May 20 TUESDAY</th></tr>
<tr><td>Room</td><td colspan="3">Plenary Room</td><td colspan="3">Plenary Room</td></tr>
<tr><td>Time</td><td colspan="3">301+302</td><td colspan="3">301+302</td></tr>
<tr><td>9:20</td><td colspan="3">Opening Ceremony</td><td colspan="3"></td></tr>
<tr><td>9:30</td><td colspan="3">Plenary Session 1
"Toyota’s Approach for Vehicles and Cities Energy and Power Management"
Takashi Uehara (TOYOTA MOTOR CORPORATION)
Moderator: Toshifumi Takaoka (TOYOTA MOTOR CORPORATION)</td><td colspan="3">Plenary Session 4
"Nissan's Strategy for Future Mobility Through Electrification"
Eiichi Akashi (Nissan Motor Co., Ltd.)
Moderator: Takashi Kato (Nissan Motor Co., Ltd.)</td></tr>
<tr><td>10:10</td><td colspan="3">Plenary Session 2
"Creating New Values for Mobility"
Kojiro Okabe (Sony Honda Mobility Inc.)
Moderator: Tomohiro Fukazu (Honda R&D Co.,Ltd)</td><td colspan="3">Plenary Session 5
"Sodium-Ion Batteries: Materials Science towards Future Energy Storage"
Shinichi Komaba (Tokyo University of Science)
Moderator: Noriko Yoshizawa (National Institute of Advanced Industrial Science and Technology)</td></tr>
<tr><td>10:50</td><td colspan="3">Plenary Session 3
" Direct-Drive In-Wheel Motor: Latest Innovations from Astemo"
Akeshi Takahashi (Astemo, Ltd.)
Moderator: Kan Akatsu (Yokohama National University)</td><td colspan="3">Plenary Session 6
"The Global Need for Wireless ERS"
Andreas Wendt (Electreon Germany GmbH)
Moderator: Takehiro Imura (Tokyo University of Science)</td></tr>
<tr><td>11:30</td><td colspan="6">Lunch by own 11:30-12:40</td></tr>
<tr><td>12:40</td><td>Room A</td><td>Room B</td><td>Room C</td><td colspan="3" rowspan="2">Keynote Speech 1
"Overcoming the Barrier of Using Second-life EV Batteries for Storage Applications."
Chris Mi (San Diego State University)
Moderator: Hiroshi Fujimoto (The University of Tokyo)</td></tr>
<tr><td>13:10</td><td>315</td><td>313+314</td><td>311+312</td></tr>
<tr><td>13:20</td><td rowspan="6">A11-WPT
Static Wireless Power Transfer 1
Chairs:
Takehiro Imura (Tokyo University of Science),
Minoru Okada
(Nara Institute of Science and Technology)</td><td rowspan="6">B11-MOT
High Speed Machines for Transportation Applications
Chairs:
Kensuke Sasaki
(Nissan Motor Co., Ltd.),
Hiroya Sugimoto
(Tokyo Denki University)</td><td rowspan="6">C11-EP
eAxle and Next Generation Propulsion System
Chair:
Satoru Hirano
(Hino Motors),
Shintaro Ohshio
(Nissan Motor Co., Ltd.)</td><td colspan="3">Break 13:10-13:20</td></tr>
<tr><td>Room A</td><td>Room B</td><td>Room C</td></tr>
<tr><td>315</td><td>313+314</td><td>311+312</td></tr>
<tr><td rowspan="3">A21-WPT
Dynamic Wireless Power Transfer 1
Chairs:
Keisuke Kusaka
(Nagaoka University of Technology), Ryosuke Ota (Tokyo Metropolitan University)</td><td rowspan="3">B21-EP
Vehicle Motion and Stability Control
Chairs:
Kantaro Yoshimoto
(Tokyo Denki University),
Takeshi Kato
(Honda R&D Co., Ltd.)</td><td rowspan="3">C21-BAT
Application of Energy Storage System 1
Chairs:
Kenji Natori
(Chiba University),
Makoto Ogawa
(Isuzu Advanced Engineering Center,Ltd)</td></tr>
<tr><td>20259012</td><td>20259015</td><td>20259020</td></tr>
<tr><td>20259013</td><td>20259016</td><td>20259021</td></tr>
<tr><td>20259014</td><td>20259017</td><td>20259022</td><td rowspan="3">20259051
20259052
20259053</td><td>20259054</td><td>20259058</td></tr>
<tr><td></td><td>20259018</td><td>20259023</td><td>20259055</td><td>20259059</td></tr>
<tr><td></td><td>20259019</td><td>20259024</td><td>20259056</td><td>20259060</td></tr>
<tr><td>14:20</td><td colspan="3">Break 14:20-14:35</td><td>20259057</td><td>20259061</td></tr>
<tr><td>14:35</td><td rowspan="6">A12-WPT
Static Wireless Power Transfer 2 & Electric Drive Technology
Chairs:
Katsuhiro Hata
(Shibaura Institute of Technology),
Toshiyuki Fujita
(The University of Tokyo)</td><td rowspan="6">B12-MOT
Performance Improvement of Electric Machines
Chairs:
Junji Kitao
(Mitsubishi Electric Corporation),
Taketsune Nakamura
(Kyoto University)</td><td rowspan="6">C12-PE
Automotive Power Electronics Technology 1
Chairs:
Takashi Nozawa
(TOYOTA MOTOR CORPORATION),
Tetsuya Kawashima
(Hitachi, Ltd.)</td><td colspan="3">Break 14:40-14:55</td></tr>
<tr><td>14:40</td></tr>
<tr><td>14:55</td><td rowspan="3">A22-WPT
Dynamic Wireless Power Transfer 2 & Electric Drive Technology
Chairs:
Yukio Yokoi
(Takushoku University),
Takehiro Imura
(Tokyo University of Science)</td><td rowspan="3">B22-MOT
Motor Drive Technologies
Chairs:
Shota Hanioka
(Mitsubishi Electric Corporation),
Kantaro Yoshimoto
(Tokyo Denki University)</td><td rowspan="3">C22-BAT
Application of Energy Storage System 2
Chairs:
Daichi Imamura
(JARI),
Ratnak Sok
(Waseda University)</td></tr>
<tr><td>20259025</td><td>20259030</td><td>20259035</td></tr>
<tr><td>20259026</td><td>20259031</td><td>20259036</td><td rowspan="3">20259062
20259063
20259064</td><td>20259066</td><td>20259071</td></tr>
<tr><td>20259027</td><td>20259032</td><td>20259037</td><td>20259067</td><td>20259072</td></tr>
<tr><td>20259028</td><td>20259033</td><td>20259038</td><td>20259068</td><td>20259073</td></tr>
<tr><td></td><td>20259029</td><td>20259034</td><td>20259039</td><td>20259065</td><td>20259069</td><td>20259074</td></tr>
<tr><td>16:15</td><td colspan="3">Break 16:15-16:30</td><td></td><td>20259070</td><td>20259075</td></tr>
<tr><td>16:30</td><td rowspan="6">A13-WPT
Electromagnetic Compatibility for Wireless Power Transfer
Chairs:
Ryosuke Ota
(Tokyo Metropolitan University),
Yukio Yokoi
(Takushoku University)</td><td rowspan="6">B13-EP
Technology for In-wheel Motor
Chairs:
Osamu Shimizu
(The University of Tokyo),
Pedram Asef
(Department of Mechanical Engineering University College London)</td><td rowspan="6">C13-PE
Automotive Power Electronics Technology 2
Chairs:
Shinya Yano
(Nissan Motor Corporation),
Tomohiro Fukazu
(Honda R&D Co., Ltd)</td><td colspan="3">Break 16:35-16:50</td></tr>
<tr><td>16:35</td></tr>
<tr><td>16:50</td><td rowspan="2">A23-WPT
Other Applications for Wireless Power Transfer
Chairs:
Minoru Okada
(Nara Institute of Science and Technology),
Katsuhiro Hata
(Shibaura Institute of Technology)</td><td rowspan="2">B23-MOT
Motor Technologies
Chairs:
Shingo Soma
(Honda R&D Co., Ltd.),
Kohei Aiso
(Shibaura Institute of Technology)</td><td rowspan="2"></td></tr>
<tr><td>20259040</td><td>20259044</td><td>20259047</td></tr>
<tr><td></td><td>20259041</td><td>20259045</td><td>20259048</td><td>20259076</td><td>20259079</td><td></td></tr>
<tr><td></td><td>20259042</td><td>20259046</td><td>20259049</td><td>20259077</td><td>20259080</td><td></td></tr>
<tr><td></td><td>20259043</td><td></td><td>20259050</td><td>20259078</td><td>20259081</td><td></td></tr>
<tr><td>17:50</td><td colspan="3"></td><td colspan="3">Move to the party venue</td></tr>
<tr><td>18:10-20:00</td><td colspan="3"></td><td colspan="3">Reception Party @ Ristorante ATTIMO *pre-reserved only
18:10-20:00</td></tr>
</table>

Time Table

Date	DAY 3 May 21 WEDNESDAY		
Room	Plenary Room		
Time	301+302		
9:20			
9:30	**Plenary Session 7** **"Honda's Pursuit of Carbon Neutrality and Electrification Technology"** Keiji Otsu (Honda R&D Co., Ltd., Honda Motor Co., Ltd.) Moderator: Kenichiro Ueda (Honda R&D Co., Ltd.)		
10:10	**Plenary Session 8** **"A Review of the Current Trends in Japan's Policies and Technological Developments Toward the Realization of a Hydrogen Society"** Hidenori Saka (New Energy and Industrial Technology Development Organization (NEDO)) Moderator: Shohji Tsushima (Osaka University)		
10:50	**Plenary Session 9** **"Cutting Edge Power Electronics Technology Applied to the Cybertruck (Tesla) and Chinese xEVs, and Japan's xEV Market Strategy for 2030."** Masayoshi Yamamoto (Nagoya University) Moderator: Kenta Emori (Nissan Motor Co., Ltd.)		
11:30	Lunch by own 11:30-12:40		
12:40	**Keynote Speech 2** **"What an ICE Can Do and What an ICE Should Do"** Hiroshi Kawanabe (Kyoto University) Moderator: Atsuharu Ota (TOYOTA MOTOR CORPORATION)		
13:10	Break 13:10-13:20		
13:20	Room A	Room B	Room C
	315	313+314	311+312
	A31 Grid & Charging Technology Chairs: Kenji Natori (Chiba University), Katsuhiro Hata (Shibaura Institute of Technology)	**B31-BAT** Energy Storage System Technologies Chairs: Noriko Yoshizawa (AIST), Kazuhito Kishi (RICOH Co., Ltd.)	**C31-FC** Fuel Cell Technology 1 Chairs: Shohji Tsushima (Osaka University), Kotaro Ikeda (TOYOTA MOTOR CORPORATION)
	20259082	20259085	20259089
	20259083	20259086	20259090
	20259084	20259087	20259091
		20259088	20259092
14:40	Break 14:40-14:55		
14:55	**A32** Advanced Simulation & Measurement Technology Chairs: Hiroya Sugimoto (Tokyo Denki University), Osamu Shimizu (The University of Tokyo)	**B32-EP** System Design for BEV and HEV Chairs: Takeshi Kato (Honda R&D Co., Ltd.), Satoru Hirano (Hino Motors)	**C32-FC** Fuel Cell Technology 2 Chairs: Kenichiro Ueda (Honda R&D Co., Ltd.), Yoshinori Yamamoto (Mitsubishi Motors Corporation)
	20259093	20259098	20259103
	20259094	20259099	20259104
	20259095	20259100	20259105
	20259096	20259101	20259106
	20259097	20259102	
16:35	Break 16:35-16:50		
16:50			**C33-FC** Fuel Cell Technology 3 Chairs: Takahiro Suzuki (Osaka University), Shohji Tsushima (Osaka University)
			20259107
			20259108
			20259109
17:50-18:10	Young Investigator Awards & Closing Ceremony		

Plenary Sessions

Day 1 May 19

Plenary Session 1
Plenary Room (301+302) 9:30 - 10:10

Toyota's Approach for Vehicles and Cities Energy and Power Management

President
Mr. Takashi UEHARA
Powertrain Company, TOYOTA MOTOR CORPORATION

Plenary Session 2
Plenary Room (301+302) 10:10 - 10:50

Creating New Values for Mobility

Director and Executive Vice President
Mr. Kojiro OKABE
Sony Honda Mobility Inc.

Plenary Session 3
Plenary Room (301+302) 10:50 - 11:30

Direct-Drive In-Wheel Motor: Latest Innovations from Astemo

Director
Dr. Akeshi TAKAHASHI
Astemo, Ltd.

Day 2 May 20

Plenary Session 5
Plenary Room (301+302) 9:30 - 10:10

Nissan's Strategy for Future Mobility Through Electrification

Executive Officer, Chief Technology Officer
Mr. Eiichi AKASHI
Nissan Motor Co., Ltd.

Plenary Session 5
Plenary Room (301+302) 10:10 - 10:50

Sodium-Ion Batteries: Materials Science towards Future Energy Storage

Department of Applied Chemistry, Faculty of Science
Prof. Shinichi KOMABA
Tokyo University of Science

Plenary Session 6
Plenary Room (301+302) 10:50 - 11:30

The Global Need for Wireless ERS

Managing Director
Dr. Andreas WENDT
Electreon Germany GmbH

Plenary Sessions

Day 3 May 21

Plenary Session 7
Plenary Room (301+302) 9:30 - 10:10

Honda's Pursuit of Carbon Neutrality and Electrification Technology

President and Representative Director, Honda R&D Co., Ltd.
Managing Executive Officer, Honda Motor Co., Ltd.
Mr. Keiji OTSU
Honda R&D Co., Ltd.
Honda Motor Co., Ltd.

Plenary Session 8
Plenary Room (301+302) 10:10 - 10:50

A Review of the Current Trends in Japan's Policies and Technological Developments Toward the Realization of a Hydrogen Society

Director, Hydrogen Supply Chain Section, Hydrogen and Ammonia Department
Mr. Hidenori SAKA
New Energy and Industrial Technology Development Organization (NEDO)

Plenary Session 9
Plenary Room (301+302) 10:50 - 11:30

Cutting Edge Power Electronics Technology Applied to the Cybertruck (Tesla) and Chinese xEVs, and Japan's xEV Market Strategy for 2030

Professor
Prof. Masayoshi YAMAMOTO
Nagoya University

Keynote Sessions

Day 2 May 20

Keynote Speech 1
Plenary Room (301+302) 12:40 - 13:10

Overcoming the Barrier of Using Second-life EV Batteries for Storage Applications

Distinguished Professor
Prof. Chris MI
San Diego State University

Day 3 May 21

Keynote Speech 2
Plenary Room (301+302) 12:40 - 13:10

What an ICE Can Do and What an ICE Should Do

Professor
Prof. Hiroshi KAWANABE
Kyoto University

Sessions

Day 1 (Monday, May 19)

Opening Ceremony

Plenary Room (9:20-9:30)

OP **Welcome Remarks**
Kan Akatsu (Chair, Steering Committee, Yokohama National University)

Plenary Session 1

Plenary Room (9:30-10:10)

Moderator: Toshifumi Takaoka (TOYOTA MOTOR CORPORATION)

20259001 **Toyota's Approach for Vehicles and Cities Energy and Power Management**
Takashi Uehara
(TOYOTA MOTOR CORPORATION)

Plenary Session 2

Plenary Room (10:10-10:50)

Moderator: Tomohiro Fukazu (Honda R&D Co., Ltd.)

20259002 **Creating New Values for Mobility**
Kojiro Okabe
(Sony Honda Mobility Inc.)

Plenary Session 3

Plenary Room (10:50-11:30)

Moderator: Kan Akatsu (Yokohama National University)

20259003 **Direct-Drive In-Wheel Motor: Latest Innovations from Astemo**
Akeshi Takahashi
(Astemo, Ltd.)

Lunch 11:30-12:40

A11-WPT **Static Wireless Power Transfer 1**

Room A (12:40-14:20)

Chairs: Takehiro Imura (Tokyo University of Science)
Minoru Okada (Nara Institute of Science and Technology)

20259012 **Development of a 500-kW Wireless Power Transfer System with Water Cooling for Windings**
Keisuke Kusaka [1], Kazuki Yamagata [1]
([1]Nagaoka University of Technology)

20259013 **Study on High-power Wireless Power Transfer for EVs Using Multiple SAE J2954 Coils - Reduction of Leakage Magnetic Field in Combined Driving of WPT Coils -**
Yasuyoshi Kaneko [1], Kota Amamiya [1], Soichiro Hamamoto [1]
([1]Saitama University)

20259014 **2 Layers Type Sheet-coil Unit for WPT for EV - New Coil Structure Saves Copper Resource -**
Sohma Hasegawa [1], Akane Arakawa [1], Masato Okabe [1]
([1]Dai Nippon Printing Co., Ltd.)

B11-MOT **High Speed Machines for Transportation Applications**

Room B (12:40-14:20)

Chairs: Kensuke Sasaki (Nissan Motor Co., Ltd.)
Hiroya Sugimoto (Tokyo Denki University)

20259015 **The Vision for a Carbon Neutral Scenario and Contributions to The Automotive Industry by TRAMI (Transmission Research Association for Mobility Innovation)**
Koh Saitoh [1]
([1]NISSAN MOTOR, Co., Ltd)

20259016 **High-speed and High-power Density Quasi-Coreless PMSM for Vehicle Propulsion**
Takashi Kosaka [1], Teruchika Ishihara [1], Ayaka Sakuma [1]
([1]Nagoya Institute of Technology)

20259017 **Design of Conductor Cross Section to Reduce Temperature Rise of High Slot Fill Aluminum Winding in High-Speed Permanent Magnet Machines**
Hiroya Sugimoto [1], Yuto Yamada [1], Jun Ebinuma [1]
([1]Tokyo Denki University)

20259018 **Development of 50 krpm Ultra-High Speed IPMSM For EV Traction**
Ren Tsunata [1], Masaki Kimura [1], Masatsugu Takemoto [1], Jun Imai [1]
([1]Okayama University)

20259019 **Improvement of PMSM Loss Estimation Accuracy Focusing on Over 50,000rpm**
Atsuya Sano [1], Kan Akatsu [1]
([1]Yokohama National University)

C11-EP **eAxle and Next Generation Propulsion System**

Room C (12:40-14:20)

Chairs: Satoru Hirano (Hino Motors, Ltd.)
Shintaro Ohshio (Nissan Motor Co., Ltd.)

20259020 **A Novel Approach for Vehicle Parking: The Rotor Lock Module**
Christof Heeger [1], Boris Berg [1], Karl Fritsch [1], Rupesh Ingle [1], Takeshi Uchiyama [2], Hiroshi Nishimura [2]
([1]Schaeffler Technology AG & Co., KG [2]Schaeffler Japan Co., Ltd.)

20259021 **A Fast Calculation Method of Iron Losses of PWM Inverter-Fed Motor in Heat Generation Control for Powertrain of Parked BEV**
Takahiro Kumagai [1], Masahiro Takemoto [1], Kenji Inokuma [1], Yoshiyuki Kimura [1], Keisuke Kawai [1]
([1]DENSO Corporation)

20259022 **Advanced Noise Prediction and Cabin Sound Optimization in BEV Using Hybrid SEA Model**
Cody McFarland [1], Drew Reminder [1], Tadanobu Aoki [1], Sanshiro Mizuno [1], Shinichi Kokabu [2]
([1]Honda Development and Manufacturing of America, [2]K and A JPN)

20259023 **Development of Powertrain System Integrated of Magnetic Gear and Multiple High-Speed Motors**
Kohei Aiso [1], Kan Akatsu [2]
([1]Shibaura Institute of Technology, [2]Yokohama National University)

20259024 **Developing IPMSM Control that Achieve High Precision with Short Calibration Time**
Kentaro Matsuo [1], Shun Taniguchi [2], Hiroaki Inaba [1]
([1]Astemo Ltd., [2]Hitachi, Ltd.)

Break 14:20-14:35 (15min)

A12-WPT **Static Wireless Power Transfer 2 & Electric Drive Technology**

Room A (14:35-16:15)

Chairs: Katsuhiro Hata (Shibaura Institute of Technology)
Toshiyuki Fujita (The University of Tokyo)

20259025 **High-Efficiency and Radiated EMI Reduction Technology for WPT Systems Using Soft-switching Active Bridge Converter**
Ryohei Okada [1], Ryosuke Ota [2], Nobukazu Hoshi [1]
([1]Tokyo University of Science, [2]Tokyo Metropolitan University)

20259026 **Theoretical Analysis and Experimental Validation of Current Balancing in Parallel MHz WPT Systems with a Coupled Inductor Pair**
Rintaro Kusui [1], Taiga Osada [1], Keisuke Kusaka [1], Jun-ichi Itoh [1]
([1]Nagaoka University of Technology)

20259027 **Methods for controlling Voltage and Power to Achieve High Efficiency Inductive Charging Under Variable Operating Conditions**
Giuseppe Guidi [1], Jon Are Suul [1,2]
([1]SINTEF Energy, [2]Norwegian University of Science and Technology (NTNU))

20259028 **User-Friendly Wireless Charging with Capacitive Coupling in Electric Mobilities**
Shinji Abe [1]
([1]Power Wave Co., Ltd.)

20259029 **Compensation Network Design for MHz-band Wireless Power Transfer in EV Charging Applications**
Itsuki Masuda [1], Sihoon Choi [1], Mitsuru Masuda [1], Jun Imaoka [1], Masayoshi Yamamoto [1]
([1]Nagoya University)

B12-MOT **Performance Improvement of Electric Machines**

Room B (14:35-16:15)

Chairs: Junji Kitao (MITSUBISHI MOTORS CORPORATION)
Taketsune Nakamura (Kyoto University)

20259030 **Performance Improvement of a 10 kW-class Halbach Array Permanent Magnet Synchronous Motor using NdFeB Laminated Permanent Magnets with Optimal Insulation Structure**
Taketsune Nakamura [1], Ryujiro Gombi [1], Emiko Tsuru [1], Tetsuhiko Mizoguchi [2], Masato Sagawa [2]
([1]Kyoto University, [2]NDFEB Corporation)

20259031 **Reducing Heavy Rare Earth Elements by Combining Permanent Magnets in IPM Motors**
Shunsuke Takahashi [1], Yutaka Sasaki [1]
([1]Hino Motors, Ltd.)

20259032 **A Study of Neodymium Magnet Replacement Technology for Electric Vehicle Traction Motor**
Kazuhiro Matsumura [1], Shunji Oki [1], Tomoaki Kaimori [1], Ryosuke Minegishi [1]
([1]Nissan Motor Co., Ltd.)

20259033 **New Multi-Tooth Inter-Modular Flux Reversal Permanent Magnet Motor**
Mohammad Reza Sarshar [1], Mohammad Amin Jalali Kondelaji [2], Pedram Asef [2], Mojtaba Mirsalim [1]
([1]Amirkabir University of Technology (Tehran Polytechnic), [2]University College London)

20259034 **Development of Low-Loss Technology Using Continuous Wave Winding**
Makoto Ito [1], Tetsuya Suto [1], Akeshi Takahashi [2]
([1]Hitachi, Ltd., [2]Astemo Ltd.)

C12-PE **Automotive Power Electronics Technology 1**

Room C (14:35-16:15)

Chairs: Takashi Nozawa (TOYOTA MOTOR CORPORATION)
Tetsuya Kawashima (Hitachi, Ltd.)

20259035 **Finite Element Based Structural Validation of Printed Circuit Board Assemblies - Under Consideration of Static-, Vibrational- and Thermal Loads**
Neubacher Christian [1], Walter Hinterberger [1]
([1]MAGNA POWERTRAIN ENGINEERING CENTER STEYR GMBH & CO KG)

20259036 **Functional Safety Assessment of High-Available 12V Power Supply Systems for Electric Vehicles with Automated Driving Functions**
Shouzheng Wang [1,2,3], Christian Winter [2], David Cello [1]
([1]Esslingen University, [2]Robert Bosch GmbH, [3]University of Stuttgart)

20259037 **An Innovative Discrete-Time Model Considering Discretization Phase Error and Its Approximation Order Analysis for IM High-Speed Drive**
Zhifa Fang [1], Shinji Doki [1]
([1]Nagoya University)

20259038 **Evaluation of Torque Feedback MTPA Control of IPMSMs Using Torque Estimation Map in the Magnetic Saturation and Regenerative Regions**
Haruka Tominaga [1], Keiichiro Kondo [1], Kazuhiko Matsunami [2]
([1]Waseda University, [2]Suzuki Motor Corporation)

20259039 **A Modulation Method for Reducing DC-link Voltage Ripple in Open-end Winding Motor Drive Systems**
Kota Sato [1], Shinya Yano [1], Kenta Emori [1]
([1]Nissan Motor Co., Ltd.)

Break 16:15-16:30 (15min)

A13-WPT **Electromagnetic Compatibility for Wireless Power Transfer**

Room A (16:30-17:50)

Chairs: Ryosuke Ota (Tokyo Metropolitan University)
Yukio Yokoi (Takushoku University)

20259040 **Novel Computational Approaches to Suppress Magnetic Field Leakage in Inductive Power Transfer Systems**
Yoshiaki Narusue [1], Daisuke Kobuchi [1], Hiroyuki Morikawa [1]
([1]The University of Tokyo)

20259041 **Harmonic Current Control Method for Selective EMI Reduction in Electric Vehicle Wireless Power Transfer System**
Hyunsoo Lee [1], Seongho Woo [1], Sungryul Huh [1], Sanguk Lee [1], Jaewon Rhee [1], Changmin Lee [1], Seungyoung Ahn [1]
([1]Cho Chun Shik Graduate School of Mobility)

20259042 **Numerical EMI Estimation of Active Implantable Medical Devices for EV Wireless Power Transfer Systems Based on Induced Electric Field and Current in the Human Body**
Takashi Hikage [1]
([1]Faculty of Information Science & Technology)

20259043 **Standardization of Human Exposure Assessment for Low-Frequency (Below 30 MHz) WPT Systems (IEC/IEEE 63184)**
Keishi Miwa [1], Akihiko Nojima [1], Teruo Onishi [2]
([1]Toyota Motor Corporation, [2]National Institute of Information and Communications Technology)

B13-EP **Technology for In-wheel Motor**

Room B (16:30-17:50)

Chairs: Osamu Shimizu (The University of Tokyo)
Pedram Asef (Department of Mechanical Engineering University College London)

20259044 **Torque Control of In-Wheel Motor Electric Vehicles Using PI-like Continuous Sliding Mode Method**
Hiroyuki Fuse [1], Marius Heydrich [1], Valentin Ivanov [1], Tokikazu Mizuguchi [2], Yuna Morimoto [2], Binh-Minh Nguyen [2], Hiroshi Fujimoto [2]
([1]Technical University of Ilmenau, [2]The University of Tokyo)

20259045 **Wheel Corner Design for Multi-actuated Electric Vehicles**
Viktar Skrickij [1], Paulius Kojis [2], Valentin Ivanov [1]
([1]Vilnius Gediminas Technical University, [2]Technical University of Ilmenau)

20259046 **New Generation of IWM-corner Traction and Braking Power Density and Efficiency Roadmap**
Jurij Kern [1], Blaž Grafenauer [1], Martin Strojnik [1], Stefano Guerra [1], Gorazd Gotovac [1]
([1]Elaphe propulsion technologies, Inc.)

C13-PE **Automotive Power Electronics Technology 2**

Room C (16:30-17:50)

Chairs: Shinya Yano (Nissan Motor Co., Ltd.)
Tomohiro Fukazu (Honda R&D Co., Ltd.)

20259047 **A Capacitance Measurement Method for Power Modules in a Half-Bridge Topology for Automotive Applications**
- A Simple Capacitance Measurement Method for Power Modules -
Jaewon Rhee [1], Sanguk Lee [1], Changmin Lee [1], Hyunsoo Lee [1], Hongseok Kim [1], Jiseong Kim [1],Seungyoung Ahn [1]
([1]Korea Advanced Institute of Science and Technology)

20259048 **Multi-port EV Charger Conducive to EV Society**
- Report on Large-scale Charging with Efficient Conversion System -
Kimihisa Furukawa [1], Yuichi Mabuchi [1], Daisuke Matsumoto [1], Hiroaki Miyata [2], Masaya Ichinose [2]
([1]Hitachi, Ltd., [2]Hitachi Industrial Products, Ltd.)

20259049 **PWM Control Method to Improve the Voltage Utilization Rate of the Inverter.**
Takeshi Kuroda [1], Takahiro Akahori [1], Taiga Sasaki [1], Akihiro Odaka [1]
([1]Fuji Electric Co., Ltd.)

20259050 **Study of SiC Power Device Application for Various Electrified Vehicle**
Satoshi Yasuda [1], Keisuke Yuki [1], Ryoji Hironaka [1]
([1]Toyota Motor Corporation)

Day 2 (Tuesday, May 20)

Plenary Session 4

Plenary Room (9:30-10:10)

Moderator: Takashi Kato (Nissan Motor Co., Ltd.)

20259004 **Nissan's Strategy for Future Mobility Through Electrification**
Eiichi Akashi
(Nissan Motor Co., Ltd.)

Plenary Session 5

Plenary Room (10:10-10:50)

Moderator: Noriko Yoshizawa (National Institute of Advanced Industrial Science and Technology)

20259005 **Sodium-Ion Batteries: Materials Science towards Future Energy Storage**
Shinichi Komaba
(Tokyo University of Science)

Plenary Session 6

Plenary Room (10:50-11:30)

Moderator: Takehiro Imura (Tokyo University of Science)

20259006 **The Global Need for Wireless ERS**
Andreas Wendt
(Electreon Germany GmbH)

Lunch 11:30-12:40

Keynote Speech 1

Plenary Room (12:40-13:10)

Moderator: Hiroshi Fujimoto (The University of Tokyo)

20259010 **Overcoming the Barrier of Using Second-life EV Batteries for Storage Applications**
Chris Mi
(San Diego State University)

Short Break 13:10-13:20 (10min)

A21-WPT **Dynamic Wireless Power Transfer 1**

Room A (13:20-14:40)

Chairs: Keisuke Kusaka (Nagaoka University of Technology)
Ryosuke Ota (Tokyo Metropolitan University)

20259051 **Report on the 4-Year Burial of 41 Coils for Dynamic Wireless Power Transfer in Asphalt Roads**
Takehiro Imura [1], Takahiro Yamahara [1], Naoya Sasa [1], Yoichi Hori [1], Hiroki Tanaka [2], Nagato Abe [2]
([1]Tokyo University of Science, [2]Toa Road Corporation)

20259052 **Proposal of Power Control Architecture of Dynamic Wireless Power Transfer for International Standardization**
Masato Maemura [1], Toshiya Hashimoto [1], Shogo Tsuge [1], Ryosuke Ikemura [1], Kazuyoshi Obayashi [2], Nobuhisa Yamaguchi [2], Keisuke Tani [2], Toshiyuki Fujita [3], Hiroshi Fujimoto [3]
([1]TOYOTA MOTOR CORPORATION, [2]DENSO CORPORATION, [3]The University of Tokyo)

20259053 **Challenges of Electrical Road System (ERS) Towards DPWT**
- Load Durability of Non-contact Wireless Power Transfer Pavement -
Nagato Abe [1], Takahiro Yamahara [2], Naoya Sasa [2], Takehiro Imura [2], Yoichi Hori [2], Hiroki Tanaka [1]
([1]Toa Road Corporation, [2]Tokyo University of Science)

B21-EP **Vehicle Motion and Stability Control**

Room B (13:20-14:40)

Chairs: Kantaro Yoshimoto (Tokyo Denki University)
Takeshi Kato (Honda R&D Co., Ltd.)

20259054 **Comparative Studies on the Performance of Antilock Braking System for a Hybrid Brake-by-wire System in EV Application**
Marius Heydrich [1], Valentin Ivanov [1]
([1]Thuringian Center of Innovation in Mobility, Smart Vehicle Systems)

20259055 **Robust Roll Stability Control of Narrow Tilting Vehicle Based on Disturbance Observer**
Sunyeop Lee [1], Hyeonseok Cho [2], Kanghyun Nam [1]
([1]Yeungnam University, [2]Hyundai (Kia Namyang) Research and Development Center)

20259056 **Design of All-Speed-Range Electronic Differential System for Front-Wheel- Independent-Drive Electric Vehicles**
Bo-Chiuan Chen [1], Yen-Ju Huang [1], Shih-Hao Chen [1]
([1]National Taipei University of Technology)

20259057 **Motor-Brake-Blending Based Roll Stability Enhancement for On Board Motor Electric Vehicles with Torque Vectoring Control**
Hiromitsu Toyota [1,2], Binh-Minh Nguyen [1], Sakahisa Nagai [1], Hiroshi Fujimoto [1], Kaoru Sawase [2]
([1]The University of Tokyo, [2]Mitsubishi Motors Corporation)

C21-BAT **Application of Energy Storage System 1**

Room C (13:20-14:40)

Chairs: Kenji Natori (Chiba University)
Makoto Ogawa (Isuzu Advanced Engineering Center, Ltd)

20259058 **Bipolar Technology: The Next Step in Battery Volume Optimization**
- Opportunities and Challenges for New Vehicle Battery Platform Concepts -
Karsten Mueller [1], Michael Clauß [1], Alexander Fandakov [1], Marc Sens [1]
([1]IAV GmbH)

20259059 **Parameter Identifications of Electrochemical NCA/Gr.SiOx Battery Cell Model Using Scaled Data from BEV Experiments**
Ratnak Sok [1], Jin Kusaka [1]
([1]Waseda University)

20259060 **Experimental and Numerical Study on Liquid Cooling Battery Thermal Management System for Battery Electric Vehicles**
- Analysis of Electrical and Coolant Parameters -
Maram Rihawi [1], Kamaleshwar Nandagopal [1], Ratnak Sok [1], Jin Kusaka [1]
([1]Waseda University)

20259061 **Simulation of Battery Cell Heating Behavior Using a Thermal Model**
Hiroshi Hatakeyama [1], Shimpachi Matsunaga [1]
([1]Horiba, Ltd.)

Break 14:40-14:55 (15min)

A22-WPT **Dynamic Wireless Power Transfer 2 & Electric Drive Technology**

Room A (14:55-16:35)

Chairs: Yukio Yokoi (Takushoku University)
Takehiro Imura (Tokyo University of Science)

20259062 **Recent Developments for Wireless Electric Road Systems - Preparing the Breakthrough -**
Andreas Wendt [1], Oren Ezer [2], Elad Levi [2], Maximilian Kneidl [3]
([1]Electreon Germany GmbH, [2]Electreon Wireless LTD, [3]Seamless Energy Technologies GmbH)

20259063 **Verification of Big Data Analysis on Dynamic Wireless Power Transfer for Electric Vehicles Focused on Traffic Signal GPS**
Yutaka Shikauchi [1], Kota Fujimoto [1], Osamu Shimizu [1], Hiroshi Fujimoto [1], Shuji Kawano [2]
([1]The University of Tokyo, [2]Honda R&D Co., Ltd.)

20259064 **Trade-offs Between WPT Infrastructure Investment and EV Investment Towards Infinite Driving**
Yudai Honma [1], Daisuke Hasegawa [1], Katsuhiro Hata [2], Takashi Oguchi [1]
([1]The University of Tokyo, [2]College of Engineering, Shibaura Institute of Technology)

20259065 **Charging Ahead - Optimal Location of Wireless Power Transfer Systems to Electrify Roads in Urban Environments -**
Thomas Byrne [1],Yudai Honma [2]
([1]University of Strathclyde, [2]The University of Tokyo)

B22-MOT **Motor Drive Technologies**

Room B (14:55-16:35)

Chairs: Shota Hanioka (Mitsubishi Electric Corporation)
Kantaro Yoshimoto (Tokyo Denki University)

20259066 **Comparative Analysis of Modulation Methods for High-Speed, Low-Inductance Motors**
Keitaro Kawarazaki [1], Taiki Mikami [1], Yuichiro Deguchi [1], Sho Morita [1], Nobukazu Hoshi [1]
([1]Tokyo University of Science)

20259067 **Current Harmonics Suppression Control for EV Traction Motor - Development of EV Traction Motor Control -**
Wataru Hatsuse [1], Toshiyuki Ajima [1]
([1]Hitachi, Ltd.)

20259068 **Development of Five-Phase Multi-Mode Reluctance Motor with Current Vector Control for xEV Application**
Ryo Kokubu [1], Kyohei Kiyota [1]
([1]Institute of Science Tokyo)

20259069 **Motor Current Control for High Speed Motor Drive Systems**
Kantaro Yoshimoto [1], Yuto Hirao [1], Tomoki Yokoyama [1]
([1]Tokyo Denki University)

20259070 **Development of High Voltage Insulation of the Motor for BEVs, HEVs and PHEVs**
Noriyoshi Yamada [1], Junichi Deguchi [1], Eiji Yanagida [1], Keiji Takizawa [1], Masahito Shirahase [2], Norihito Kimura [2]
([1]TOYOTA MOTOR CORPORATION, [2]SOKEN, INC.)

C22-BAT **Application of Energy Storage System 2**

Room C (14:55-16:35)

Chairs: Daichi Imamura (JARI)
Ratnak Sok (Waseda University)

20259071 **Improving Battery Pack Model Accuracy of Next-generation Light-duty Battery Electric Trucks under JE05 Driving Cycle**
- Lookup Table Generated from an Electrochemical Cell Model with Temperature Consideration -
Xinwei Li [1], Haoxiang Li [1], Ratnak Sok [1], Keiki Tanabe [2], Goro Iijima [2], Jin Kusaka [1]
([1]Waseda University, [2]Mitsubishi FUSO Truck & Bus Corporation)

20259072 **Simulation of Electric Mobility Concepts**
- Swappable Batteries and Battery Swapping Stations -
Sebastian Brulin [1], Tamon Toyooka [2], Lydia Fischer [1], Tobias Rodemann [1], Florian Kreuchauff [3]
([1]Honda Research Institute Europe, [2]Institute of Science Tokyo, [3]Honda R&D Europe)

20259073 **Application of Battery Digital Twin to Charge Planning Problem for a Fleet of Electric Vehicles**
Subhajeet Rath [1], Alenka Beckers [1], Paul Netto [1], Robinson Medina [1], Steven Wilkins [1,2]
([1]TNO, Dept. of Powertrains, [2]Eindhoven University of Technology)

20259074 **AI Driven Digital Twin for Improved Battery Performance and Predictive Maintenance**
- From Data to Insights for Faster Engineering Decisions -
Nikolaus Keuth [1], Gerhard Schagerl [1]
([1]AVL List GmbH.)

20259075 **Battery Diagnostics and Monitoring Methods**
- A Comparative Analysis of Active versus Passive Approaches–
Avedis Dadikozyan [1], Camiel Beckers [1], Tim Meulenbroeks [1,2], Erik van den Tillaart [1], Steven Wilkins [1,2]
([1]Powertrains Dept., [2]Eindhoven University of Technology)

Break 16:35-16:50 (15min)

A23-WPT **Other Applications for Wireless Power Transfer**

Room A (16:50-17:50)

Chairs: Minoru Okada (Nara Institute of Science and Technology)
Katsuhiro Hata (Shibaura Institute of Technology)

20259076 **A Waveguide Power Transfer for Electric Vehicles in Motion**
Yuichi Masuda [1,2], Naoya Takahashi [3], Katsuhiro Hata [3], Hiroyuki Shinoda [1]
([1]The University of Tokyo, [2]2DC, Inc., [3]Shibaura Institute of Technology)

20259077 **Latest Trends in Rulemaking for Capacitive Coupling Wireless Power Transmission Systems Using 6.7MHz Frequency Band**
Kunihiko Sasaki [1], Tetsuo Endo [2], Masahiro Hanazawa [2], Shinji Abe [3]
([1]Nagoya Institute of Technology, [2]TAISEI CORPORATION, [3]Power Wave Co., Ltd.)

20259078 **Toward Extension of Undersea EM Field Propagation Distance**
Ikuo Awai [1], Takashi Ohira [1], Shunsuke Hino [2], Hiroki Shigetomi [2], Masayuki Okamoto [2], Yoshiki Mizukami [3]
([1]Fujiwaves Co. LTD., [2]Ube College, [3]Yamaguchi University)

B23-MOT **Motor Technologies**

Room B (16:50-17:50)

Chairs: Shingo Soma (Honda R&D Co., Ltd.)
Kohei Aiso (Shibaura Institute of Technology)

20259079 **Applying the Drive Shaft Torsional Vibration Control to Induction Motors**
Kohei Kawasaki [1], Sho Ohno [1], Hiroyuki Komatsu [1], Yui Ito [1], Akira Sawada [1], Takashi Nakajima [1]
([1]Nissan Motor Co., Ltd.)

20259080 **Energy Management Strategy for Dual IM-PMSM Electric Vehicles**
An-Toan Nguyen [1,4], Binh-Minh Nguyen [2], João Pedro F. Trovão [1,3], Minh C. Ta [1]
([1]Université de Sherbrooke, [2]The University of Tokyo, [3]Polytechnic of Coimbra, [4]Faculty of Engineering and Technology)

20259081 **Potential for Improving Motor Performance Using Thermosetting Molding Materials**
Shinya Yamamoto [1], Hirofumi Kuroda [1], Takahiro Harada [1], Wataru Kosaka [1], Atsunori Nishikawa [1]
([1]SUMITOMO BAKELITE CO., LTD.)

Reception Party

Ristorante ATTIMO (18:10-20:00)

Day 3 (Wednesday, May 21)

Plenary Session 7

Plenary Room (9:30-10:10)

Moderator: Kenichiro Ueda (Honda R&D Co., Ltd.)

20259007 **Honda's Pursuit of Carbon Neutrality and Electrification Technology**
Keiji Otsu
(Honda R&D Co., Ltd.)

Plenary Session 8

Plenary Room (10:10-10:50)

Moderator: Shohji Tsushima (Osaka University)

20259008 **A Review of the Current Trends in Japan's Policies and Technological Developments Toward the Realization of a Hydrogen Society**
Hidenori Saka
(New Energy and Industrial Technology Development Organization (NEDO))

Plenary Session 9

Plenary Room (10:50-11:30)

Moderator: Kenta Emori (Nissan Motor Co., Ltd.)

20259009 **Cutting Edge Power Electronics Technology Applied to the Cybertruck (Tesla) and Chinese xEVs, and Japan's xEV Market Strategy for 2030**
Masayoshi Yamamoto
(Nagoya University)

Lunch 11:30-12:40

Keynote Speech 2

Plenary Room (12:40-13:10)

Moderator: Atsuharu Ota (TOYOTA MOTOR CORPORATION)

20259011 **What an ICE Can Do and What an ICE Should Do**
Hiroshi Kawanabe
(Kyoto Univeristy)

Short Break 13:10-13:20 (10min)

A31 **Grid & Charging Technology**

Room A (13:20-14:20)

Chairs: Kenji Natori (Chiba University)
Katsuhiro Hata (Shibaura Institute of Technology)

20259082 **Reduction of grid electricity demand of BEV's by applying integrated photovoltaics - A modelling approach -**
Lenneke Slooff[1], Anna J. Carr[1], Ashish Binani[1], Oscar van de Water[1], Michiel Zult[2], Akshay Bhoraskar[2], René van Gijlswijk[2]
([1]TNO – Energy and Materials Transition, [2]TNO – Mobility and Built Environment)

20259083 **Impact of Electricity Prices and Tariffs on Smart Charging: A Comparison Between Norway and Denmark Using Receding Horizon Optimization**
Anna Malkova [1], Jan Martin Zepter [1], Magnus Korpås [2], Mattia Marinelli [1]
([1]Technical University of Denmark, [2]Norwegian University)

20259084 **Evaluating 48 V and New Architectures for the Low Voltage Power Supply**
Richard Weldle [1], Takuya Mimori [1]
([1]Schaeffler AG)

B31-BAT **Energy Storage System Technologies**

Room B (13:20-14:20)

Chairs: Noriko Yoshizawa (National Institute of Advanced Industrial Science and Technology)
Kazuhito Kishi (RICOH Co., Ltd.)

20259085 **Ultrafast Charging for Different Applications with SuperBatteries and Supercapacitors**
Linus Froboese [1], Viviana Piccinni [1]
([1]Skeleton Technologies GmbH)

20259086 **Diagnosis Technology for Lithium Ion Battery Degradation**
- A Battery Pack of EV Can Be Analyzed by Square-wave Current EIS -
Shun Egusa [1,2], Tetsuya Osaka [2], Toshiyuki Momma [1]
([1]Research Organization of Nano & Life Innovation, Waseda University, [2]EC SENSING, Inc.)

20259087 **Analysis of Influencing Factors of Electric Bus Energy Consumption**
Xiaopan Li [1], Baoku Zhang [1], Chongshan Yang [1], Hua Shi [2]
([1]Jiangsu Alfa Bus Corporation, [2]Shanghai ECAR New Energy Vehicles Technology Corporation)

20259088 **The Role of Mg in the Circular Economy and its Potential as an Energy Carrier**
-Agriculture (Forestry), Fishery and Modern Industry-
Hiroyuki Shibata [1], Michiru Sakamoto [2], Shiori Kumagai [2], Masahiko Maeda [2]
([1]Tohoku University, [2]The Council of Circulating Society, Sendai)

C31-FC **Fuel Cell Technology 1**

Room C (13:20-14:20)

Chairs: Shohji Tsushima (Osaka University)
Kotaro Ikeda (TOYOTA MOTOR CORPORATION)

20259089 **Carbon Monoxide Poisoning and Recovery on a Polymer Electrolyte Fuel Cell with a Hydrogen Circulation System**
Yoshiyuki Matsuda [1], Takahiro Shimizu [1], Daichi Imamura [1]
([1]Japan Automobile Research Institute)

20259090 **Verification of a Novel Hydrogen Refueling Method for HDVs**
- Significant Reduction for Refueling Time and Hydrogen Pressure Storage Volume -
Kiyoshi Handa [1], Tatsuya Rembutsu [2], Tomonari Komiyama [3]
([1]HONDA R&D Co., Ltd., [2]Tokico System Solutions, Ltd., [3]HySUT)

20259091 **Development of a New Structural Fuel Cell and Stack**
Manabu Iwaida [1], Choichi Ishikawa [1], Takashi Kato [1], Kazuo Nunokawa [1]
([1]Honda R&D Co., Ltd.)

20259092 **Approach to Building Technology for Mass Production of Fuel Cell Systems for Social Implementation -**
Hiroaki Kawanishi [1], Yusuke Wada [1], Keita Iwaya [1]
([1]HONDA R&D Co., Ltd.)

Break 14:40-14:55 (15min)

A32 **Advanced Simulation & Measurement Technology**

Room A (14:55-16:35)

Chairs: Hiroya Sugimoto (Tokyo Denki University)
Osamu Shimizu (The University of Tokyo)

20259093 **Standardisation of Hardware Protected Security Environments GlobalPlatform Alignment with SAE's J3101: An Opportunity for Japanese Standardisation Alignment**
Francesca Forestieri [1], Gil Bernabeu [1]
([1]GlobalPlatform)

20259094 **Uncertainty when Testing Electric Vehicle Drive Trains - Propagation of Measurement Uncertainty to Power (Loss), Efficiency and Energy Consumption -**
Alexander Stock [1], Klaus Lang [1], Marjorie Takai [2]
([1]Hottinger Brüel & Kjær GmbH, [2]Spectris Co., Ltd.)

20259095 **Securing the Future of Electric Vehicles: A Novel Approach Using MILS and Zero Trust Architecture**
Jun Anzai [1], Yoshiharu Imamoto [1]
([1]Panasonic Automotive Systems Co., Ltd.)

20259096 **Full EV Vehicle Model for Digital Authentication Through Virtual Testing - Comprehensive CO2 Reduction and New Manufacturing Methods -**
Kimitoshi Tsuji [1], Toshiji Kato [2], Tsunehiro Saito [3], Masahiro Okamura [4]
([1]Digital Twins Inc., [2]Doshisha University, [3]AGC Inc. [4]JSOL, INC.)

20259097 **Quantifying Traffic Congestion Caused by Vehicle Platooning - A Statistical Approach and Empirical Validation –**
Kizuku Yamada [1], Takashi Nishikiori [1], Masanori Shimada [1], Tomomi Yamada [1], Toshiya Hashimoto [1]
([1]TOYOTA MOTOR CORPORATION)

B32-EP **System Desing for BEV and HEV**

Room B (14:55-16:35)

Chairs: Takeshi Kato (Honda R&D Co., Ltd.)
Satoru Hirano (Hino Motors, Ltd.)

20259098 **Pathways to the Next Stage of E-Mobility - Affordable, Safe and Sustainable -**
Gerhard Meister [1], Adam Dendrinos [1], Tom Horvat [1], Benjamin Langer [2], Martin Rothbart
([1]AVL List GmbH, [2]AVL Software and Functions GmbH)

20259099 **Sustainable EDU Solutions - AVL's Pathway Forward to Support e-Mobility with Power Dense, Efficient, Sustainable and Cost Attractive Electric Drive Unit (EDU) Solutions -**
Wilhelm Vallant [1], Mathias Deiml [2], Gernot Fuckar [1], Martin Rothbart [1], Kristian Fleck [1]
([1]AVL List GmbH, [2]AVL Software and Functions GmbH, [3]AVL List GmbH)

20259100 **Investigation of Safety Design Methods for Low to Medium Speed Mobility Systems in Logistics**
Shota Hori [1], Takuma Hirasawa [1], Koji Hagiwara [1], Shigehiro Sugihira [1], Yasutaka Fujiwara [1], Masakazu Owatari [1]
([1]TOYOTA MOTOR CORPORATION.)

20259101 **THS Engine Torque Detection System Using Motor/Generator Resolver - xEV Technology That Utilizes the Potential of Engine for the Multi-Pathway Approach -**
Kohei Yasumura [1], Nobuhiro Kotake [1], Takeshi Kitahata [1], Takashi Suzuki [1], Koichiro Muta [1]
([1]Toyota Motor Corporation)

20259102 **The Electrified Control Technology for Toyota's L4A0 and L580**
- Electrification Control Technologies for Motor-Generator -
Mu Hu [1], Masayuki Baba [1], Yoshiyuki Teratani [2], Yoshiaki Tsuruta [2], Nobufusa Kobayashi [2]
([1]Toyota Motor North America, [2]Toyota Motor Corporation)

C32-FC **Fuel Cell Technology 2**

Room C (14:55-16:35)

Chairs: Kenichiro Ueda (Honda R&D Co., Ltd.)
Yoshinori Yamamoto (MITSUBISHI MOTORS CORPORATION)

20259103 **Capillary Pressure-Water Saturation Relations for Gas Diffusion Layers Affecting Water Transport and PEFC Polarization Behaviors**
Shohji Tsushima [1], Shota Tateyama [1], Takahiro Suzuki [1], Naoki Hirayama [2], Mitsunori Nasu [2], Masahiro Watanabe [3], Akihiro Iiyama [3], Makoto Uchida [3]
([1]Osaka University, [2]Enomoto Co., Ltd., [3]University of Yamanashi)

20259104 **A Novel Approach to Polymer Electrolyte Fuel Cell Electrode Slurries**
Takahiro Suzuki [1], Ryo Kirigaya [1], Hajime Ooya [1], Kayoko Tamoto [2], Makoto Uchida [2], Shohji Tsushima [1]
([1]Osaka University, [2]University of Yamanashi)

20259105 **Energy Management System for Hydrogen Vehicles Considering State of Health of Fuel Cells and Lithium Batteries**
- State of Health Integration Using LSTM and ANN-based ECMS for Improved Hydrogen Consumption-
Chi-Chang Huang [1], Zheng-Wei Fan [1], Yi-Hsuan Hung [1], Tsu-Yang Tsai [2]
([1]National Taiwan Normal University, [2]Industrial Technology Research Institute)

20259106 **The StasHH Size, Interface, and Testing Protocol Standards for Fuel Cell Modules in Heavy-Duty Applications**
- Definition of an Industry-Driven Fuel Cell Module Standard -
K.J. Mrozewski [1], A. Balaji [1], C. Bekdemir [1], R. Bouwman [2], H. Lundkvist [3]
([1]TNO Powertrains, [2]VDL Enabling Transport Solutions, [3]SINTEF Digital)

Break 16:35-16:50 (15min)

C33-FC **Fuel Cell Technology 3**

Room C (16:50-17:50)

Chairs: Takahiro Suzuki (Osaka University)
Shohji Tsushima (Osaka University)

20259107 **Advanced Ion-Pair High-Temperature Polymer Electrolyte Membrane Fuel Cells**
Liang Wang [1], Keiichi Okubo [2], Atsushi Hiraide [2], Satoshi Nagao [2], Hiroki Okabe [2], Masaki Ando [2]
([1]Toyota Research Institute of North America, [2]Toyota Motor Corporation)

20259108 **Development of an Integrated Fuel Cell System Simulator "FC-DynaMo"**
- Toward Acceleration of Advanced Research and Product Development -
Shigeki Hasegawa [1], Sanghong Kim [2], Miho Kageyama [1], Motoaki Kawase [1]
([1]Kyoto University, [2]Tokyo University of Agriculture and Technology)

20259109 **Evaluation of Standardized Testing Protocols for Fuel Cell Modules in Heavy-Duty Applications**
- Measurement Results from 7 Standard Sized Fuel Cell Prototypes -
A. Balaji [1], K.J. Mrozewski [1], C. Bekdemir [1], Y. Wang [2], E. Havret [3]
([1]TNO Powertrains, [2]FEV, Motor Hybrid and Fuel Cell Powertrains, [3]CEA, Energy Division)

Young Investigator Awards, Closing Ceremony

Room A (17:50-18:10)

Abstracts

Day 1 (Monday, May 19)

A11-WPT **Static Wireless Power Transfer 1**

Room A (12:40-14:20)

Chairs: Takehiro Imura (Tokyo University of Science)
Minoru Okada (Nara Institute of Science and Technology)

20259012 **Development of a 500-kW Wireless Power Transfer System with Water Cooling for Windings**

Keisuke Kusaka [1], Kazuki Yamagata [1]
([1]Nagaoka University of Technology)

Abstract:
The demand for charging power is rapidly increasing to shorten the charging time for electric vehicles (EVs) because the battery capacity of EVs on the market has grown to extend their driving range. In the standard for the EV charger CHAdeMO, the output power of the wired charger has been increased from 50 to 350–500 kW. This demand for increased capacity also applies to wireless power transfer (WPT) systems. This paper reports on the development of the 500-kW wireless power transfer system with water-cooled windings. First, a hollow copper wire for water cooling is evaluated for high-power transmission. The hollow copper wire lets the water cool from inside the transmission coils' windings. Then, the wireless power transfer system with an output power of 500 kW with a single transmission coil and a single receiving coil is designed based on the electromagnetic analysis. Finally, the 500-kW prototype is developed and demonstrated. The experimental results show that the 500-kW transmission is achieved without any heat problems. The maximum transmission efficiency is 92% at an output power of 500 kW.

20259013 **Study on High-power Wireless Power Transfer for EVs Using Multiple SAE J2954 Coils - Reduction of Leakage Magnetic Field in Combined Driving of WPT Coils -**

Yasuyoshi Kaneko [1], Kota Amamiya [1], Soichiro Hamamoto [1]
([1]Saitama University)

Abstract:
In wireless power transfer, it is possible to increase power by using multiple coils. However, there is an issue that the leakage magnetic field is larger than that of a single coil power transfer. In this research, we examined the reduction methods of leakage magnetic field when multiple SAE J2954 WPT3/Z3 coils were driven simultaneously, focusing on the changes in current phase and the use of passive shield type cancel coils. By combining these two reduction methods, we were able to further reduce the leakage magnetic field.

20259014 **2 Layers Type Sheet-coil Unit for WPT for EV - New Coil Structure Saves Copper Resource -**

Sohma Hasegawa [1], Akane Arakawa [1], Masato Okabe [1]
([1]Dai Nippon Printing Co., Ltd.)

Abstract:
With the spread of EVs, the expectation for wireless power transfer (WPT) systems is increasing that can charge EVs easily. The authors have developed a sheet coil for this system that is thinner and lightweight compared to the conventional coil with Litz wire and have reported that it is possible to make the thinner power receiving unit installed in a vehicle by bringing the ferrite and aluminum shield closer together. In this paper, we propose that two-layer copper coil structure which can improve performance and save precious copper resources.

B11-MOT **High Speed Machines for Transportation Applications**

Room B (12:40-14:20)

Chairs: Kensuke Sasaki (Nissan Motor Co., Ltd.)
Hiroya Sugimoto (Tokyo Denki University)

20259015 **The Vision for a Carbon Neutral Scenario and Contributions to the Automotive Industry by TRAMI (Transmission Research Association for Mobility Innovation)**
Koh Saitoh [1]
([1]NISSAN MOTOR, Co., Ltd)

Abstract:
Due to the worsening environmental issues on Earth, the importance of reducing CO2 emissions from automobiles has increased more than ever, and the expansion of electric vehicles is urgently needed. In TRAMI's carbon-neutral scenario, we emphasize research on the technology of miniaturizing and lightweighting electric drive systems through ultra-high-speed motors to simultaneously address the shortage of material resources for vehicle drive motors and the increase in CO2 emissions during manufacturing. Additionally, the miniaturization of electric drive systems enhances the design flexibility in electric vehicle development, leading to the creation of new attractions for electric vehicles. TRAMI aims to contribute through research activities to ensure that Japan's automotive industry leads the expansion of electric vehicles in the future.

20259016 **High-speed and High-power Density Quasi-Coreless PMSM for Vehicle Propulsion**
Takashi Kosaka [1], Teruchika Ishihara [1], Ayaka Sakuma [1]
([1]Nagoya Institute of Technology)

Abstract:
This paper deals with a high-speed and high-power density quasi-coreless permanent magnet synchronous motor for vehicle traction drives. Stator body is composed of carbon fiber reinforced plastic, a small amount of soft magnetic composite core and aluminum windings. Rotor body consists of carbon fiber reinforced plastic frame and polar anistropic magnet. FEA-based design study on a 150kW quasi-coreless permanent magnet synchronous motor rotating at 50,000r/min as the maximum speed with high-power density more than 10kW/kg is reported and the design results are discussed.

20259017 **Design of Conductor Cross Section to Reduce Temperature Rise of High Slot Fill Aluminum Winding in High-Speed Permanent Magnet Machines**
Hiroya Sugimoto [1], Yuto Yamada [1], Jun Ebinuma [1]
([1]Tokyo Denki University)

Abstract:
This paper proposes a novel conductor cross section of high slot fill aluminum winding in high-speed and high power density electric machines for transportation applications such as electric vehicles and electric aircrafts. The maximum rotational speed and the power density are 50,000 min^{-1} and 10 kW/kg, respectively. The maximum current frequency is 3.3 kHz with the number of rotor poles is eight; and therefore, it has serious winding AC loss. The high slot fill aluminum winding is a great solution to reduce both DC and AC losses. The loss reduction contributes to reduce the temperature rise of the winding. In this paper, the cross-sectional shape of the aluminum distributed winding is proposed to reduce the temperature rise at high-speed region. In experiments, it is shown that the proposed winding in a prototype motorette can reduce the temperature rise more than 50% at 3.3 kHz.

20259018 **Development of 50 krpm Ultra-High Speed IPMSM For EV Traction**
Ren Tsunata [1], Masaki Kimura [1], Masatsugu Takemoto [1], Jun Imai [1]
([1]Okayama University)

Abstract:
This paper develops an ultra-high-speed 50 krpm motor for traction applications. A typical IPMSM structure is used for the rotor in this paper. At ultra-high speeds, the winding structure has a large effect on winding losses. Hence, this paper investigates the AC loss of the winding. The AC loss includes the eddy current loss and circulating current loss in the winding. Additionally, the ultra-high speed raises

concerns about the rotor's critical speed. Therefore, in this paper, the shaft of the developed motor is manufactured, and the critical speed is evaluated.

20259019 **Improvement of PMSM Loss Estimation Accuracy Focusing on Over 50,000rpm**

Atsuya Sano [1], Kan Akatsu [1]
([1]Yokohama National University)

Abstract:
Permanent Magnet Synchronous Motor (PMSM) offers high efficiency and high-power density, however it also presents resource-related risks due to the use of rare-earth magnets and copper. As a solution, ultra-high-speed, miniaturized PMSM aimed at conserving resources is attracting attention. However, there are no studies that evaluate losses in the ultra-high-speed operating region using actual machine measurements and analysis. In this paper, we target a PMSM equivalent to 8-poles with a maximum speed of 50,000 rpm to measure actual machine losses and assess the accuracy of iron loss estimation. We clarify the differences between the actual machine measurements and the analysis results at a maximum electrical angular frequency of 3.3 kHz.

C11-EP **eAxle and Next Generation Propulsion System**

Room C (12:40-14:20)

Chairs: Satoru Hirano (Hino Motors, Ltd.)
Shintaro Ohshio (Nissan Motor Co., Ltd.)

20259020 **A Novel Approach for Vehicle Parking: The Rotor Lock Module**

Christof Heeger [1], Boris Berg [1], Karl Fritsch [1], Rupesh Ingle [1], Takeshi Uchiyama [2], Hiroshi Nishimura [2]
([1]Schaeffler Technology AG & Co.,KG [2]Schaeffler Japan Co., Ltd.)

Abstract:
To reduce the complexity of modern electric drives, a holistic functional approach is essential. The function of preventing a parked vehicle rolling away is often realized by a mechanical park lock actuator with a pawl and ratchet wheel within the reducer: A solution that requires significant installation space and complicate assembly processes. The innovative rotor lock concept uses the possibility of precise rotor position control of the e-machine to engage the park lock with low forces. That allows the park lock function to be relocated from the reducer to the rotor shaft as it shrinks in size. This novel approach enables the integration of additional functions into a module like the rotor position sensor and the excitation system for EESM applications. Consequently, the Rotor Lock Module reduces weight, packaging and complexity which leads to a highly cost-effective system design.

20259021 **A Fast Calculation Method of Iron Losses of PWM Inverter-Fed Motor in Heat Generation Control for Powertrain of Parked BEV**

Takahiro Kumagai [1], Masahiro Takemoto [1], Kenji Inokuma [1], Yoshiyuki Kimura [1], Keisuke Kawai [1]
([1]DENSO Corporation)

Abstract:
This paper proposes a fast calculation method for the motor iron loss which is one of the heat sources in the specific control in order to generate a heat source for heater and battery heating by conducting a current into the powertrain of the parked battery electric vehicle (BEV), which is so-called "heat generation control" in this paper. This first process is to create two databases (A) for low-frequency iron loss calculated with a current source simulating a current control system and (B) for high-frequency iron loss calculated with a voltage source simulating a PWM inverter, with a finite element analysis (FEA). Next, the motor iron loss is calculated by referring to those two databases depending on the control parameters and condition in the heat generation control, which realizes the fast calculation. In comparison with a general iron loss calculation by combining a control/circuit simulation and a FEA, the calculation time is reduced by 93% while maintaining an accuracy of 5.4% error rate at 1p.u. current amplitude.

20259022 **Advanced Noise Prediction and Cabin Sound Optimization in BEV Using Hybrid SEA Model**

Cody McFarland [1], Drew Reminder [1], Tadanobu Aoki [1], Sanshiro Mizuno [1], Shinichi Kokabu [2]
([1]Honda Development and Manufacturing of America, [2]K and A JPN)

Abstract:
The rise of BEV has highlighted high-frequency motor and gearbox noise, creating new challenges for automotive noise prediction. Current simulation methods struggle with high-frequency noise predictions. Hybrid statistical energy analysis (HSEA), which combines analytical and experimental methods, enables more accurate noise prediction and assessment of vehicle design modifications, particularly for cabin noise. This paper demonstrates the effectiveness of HSEA, especially when addressing noise caused by acoustically sensitive structural transfer paths, and its improvement potential for vehicle development efficiency.

20259023 **Development of Powertrain System Integrated of Magnetic Gear and Multiple High-Speed Motors**

Kohei Aiso [1], Kan Akatsu [2]
([1]Shibaura Institute of Technology, [2]Yokohama National University)

Abstract:
A technical innovation for the downsizing of motor system is necessary to realize the saving energy, and roomy and comfortable car interior space in Electric Vehicles (EVs). In this research, a novel powertrain system of multiple high speed motors and Magnetic Multiple Spur Gear (MMSG) for the electric vehicle is proposed. The MMSG can achieve the high transmitted efficiency by magnetically transmission using permanent magnets. Moreover, the drive system realizes the drastic downsizing by using multiple high speed motors which rotate in the speed region of 50000 min^{-1}. In this paper, the motor system is designed for a powertrain of EVs, the optimal configuration of the gear ratio, number of motors, and motor shape from the perspective of downsizing and improving efficiency is clarified.

20259024 **Developing IPMSM Control that Achieve High Precision with Short Calibration Time**

Kentaro Matsuo [1], Shun Taniguchi [2], Hiroaki Inaba [1]
([1]Astemo Ltd., [2]Hitachi, Ltd.)

Abstract:
In recent years, motor-powered vehicles (xEVs) such as hybrid vehicles, plug-in hybrid vehicles, and electric vehicles have attracted attention due to growing interest in environmental issues. E-motor control of inverter/e-motor systems for xEVs requires the following characteristics. High requirements for torque accuracy and torque response, necessity to adjust (calibrate) control parameters using the actual machine, and presence of many models. Therefore, e-motor control is required to realize high precision in short calibration time. Therefore, we developed new calibration methods and evaluated it with a 200kW-class EV motor.

A12-WPT **Static Wireless Power Transfer 2 & Electric Drive Technology**

Room A (14:35-16:15)

Chairs: Katsuhiro Hata (Shibaura Institute of Technology)
Toshiyuki Fujita (The University of Tokyo)

20259025 **High-Efficiency and Radiated EMI Reduction Technology for WPT Systems Using Soft-switching Active Bridge Converter**

Ryohei Okada [1], Ryosuke Ota [2], Nobukazu Hoshi [1]
([1]Tokyo University of Science, [2]Tokyo Metropolitan University)

Abstract:
In wireless power transfer systems, applying a soft-switching technology increases power losses from reactive currents circulating in the circuit, reducing overall efficiency. To address this problem, the authors have proposed a soft-switching active bridge converter. The proposed converter utilizes the reactive current generated in an auxiliary circuit (LC circuit) for soft switching instead of a resonant network. This approach significantly reduces the reactive current flowing through the resonant network

and power devices. This paper summarizes the authors' previous findings on the proposed converter and presents the efficiency improvement method. Experimental results have shown that the proposed system achieves higher efficiency than the conventional system with soft switching while reducing radiated EMI compared to the conventional system with hard switching.

20259026 **Theoretical Analysis and Experimental Validation of Current Balancing in Parallel MHz WPT Systems with a Coupled Inductor Pair**

Rintaro Kusui [1], Taiga Osada [1], Keisuke Kusaka [1], Jun-ichi Itoh [1]
([1]Nagaoka University of Technology)

Abstract:
This paper presents a current balancing method utilizing a coupled inductor pair for a megahertz-band wireless power transfer (WPT) system, aiming to reduce the size and weight of transmission coils. In conventional systems, inverters are connected in parallel to enhance transmission power. However, it is crucial to mitigate circulating currents between the parallel-connected inverters to prevent thermal imbalance and potential damage. The proposed balancer equalizes the output currents of the inverters while suppressing common-mode currents. Its performance is evaluated through simulations and experiments. Simulation results for a 6.78 MHz WPT system demonstrate that the inverter output current aligns with the average current, with an error of only 0.17%. Furthermore, an experimental prototype operating at 85 kHz successfully transmits 2 kW of power while maintaining a current deviation of just 0.18% from the average.

20259027 **Methods for Controlling Voltage and Power to Achieve High Efficiency Inductive Charging under Variable Operating Conditions**

Giuseppe Guidi [1], Jon Are Suul [1,2]
([1]SINTEF Energy, [2]Norwegian University of Science and Technology (NTNU))

Abstract:
This paper discusses the problem of controlling the power flow in inductive charging systems under variable operating conditions when the only degree of freedom is the modulation of the primary-side converter. Operating conditions are dictated by coupling and by the dc voltages on either side of the system. When operating conditions are deviating from the rated values and frequency cannot be changed, voltage regulation is needed to keep the power flow at the required level without exceeding any of the system maximum limits. Several methods are analyzed and compared, with the aim of finding the best strategy to achieve precise and safe power regulation without incurring excessive losses, both in the coils and in the power converters. It is shown that it is key for maintaining high efficiency to avoid switching of high currents, which happens when adopting phase-shift modulation. Pulse-skipping techniques limit the switching losses but may give rise to low-frequency oscillations. This aspect is analyzed and a modified Delta-Sigma Modulation algorithm for pulse-skipping pattern generation is presented, which prevents the appearance of limit cycles that excite the poorly damped natural oscillation mode of the system.

20259028 **User-Friendly Wireless Charging with Capacitive Coupling in Electric Mobilities**

Shinji Abe [1]
([1]Power Wave Co., Ltd.)

Abstract:
This comprehensive study introduces an innovative capacitive coupling-based wireless charging system specifically engineered for electric mobility applications. The system, which was initially conceptualized and developed for deployment in shared e-scooter fleets, represents a significant advancement in charging technology by completely eliminating the need for manual charging operations, substantially reducing operational costs associated with fleet management, and dramatically enhancing the overall user experience through automated charging capabilities. The system's sophisticated design incorporates several groundbreaking technical features, including remarkable tolerance to positioning variations during charging operations, an ultra-compact charging port with an exceptionally low 35 mm profile for seamless environmental integration, and an advanced non-invasive receiver unit that can be mounted on vehicles without requiring structural modifications. Through careful engineering and sophisticated design principles, the system demonstrates excellent scalability potential, enabling

successful implementation across a diverse range of applications from personal electric vehicles (EVs) to automated guided vehicles (AGVs), thereby contributing significantly to the broader adoption of sustainable electric transportation solutions in urban environments.

20259029 **Compensation Network Design for MHz-band Wireless Power Transfer in EV Charging Applications**

Itsuki Masuda [1], Sihoon Choi [1], Mitsuru Masuda [1], Jun Imaoka [1], Masayoshi Yamamoto [1]
([1]Nagoya University)

Abstract:
This article proposes design guidelines and loss analysis methods for compensation network in capacitive power transfer systems. The design guidelines focus on loss reduction of passive devices and output characteristics (constant current or voltage). By this method, the loss of topology in advance is predicted, and the effect is verifiable. In addition, it allows for a comparison of conventional topologies in a unified manner. The presentation will introduce the proposed topology based on these guidelines.

B12-MOT **Performance Improvement of Electric Machines**

Room B (14:35-16:15)

Chairs: Junji Kitao (MITSUBISHI MOTORS CORPORATION)
Taketsune Nakamura (Kyoto University)

20259030 **Performance Improvement of a 10 kW-class Halbach Array Permanent Magnet Synchronous Motor Using NdFeB Laminated Permanent Magnets with Optimal Insulation Structure**

Taketsune Nakamura [1], Ryujiro Gombi [1], Emiko Tsuru [1], Tetsuhiko Mizoguchi [2], Masato Sagawa [2]
([1]Kyoto University, [2]NDFEB Corporation)

Abstract:
Achieving high efficiency and high power density characteristics in automobile traction motors is an important research and development issue. We have investigated the characteristics of a 10 kW-class permanent magnet motor with a Halbach structured permanent magnet rotor using NdFeB laminated magnets. First, we optimized the insulation layer of the NdFeB laminated permanent magnet through experiments and 3D electromagnetic field analysis. Then, we used the laminated permanent magnets with the above-mentioned optimized insulation layer and performed 3D electromagnetic field analysis of the 10 kW-class Halbach motor of which the experimental results have already been reported. The analysis results show that the introduction of NdFeB laminated permanent magnets improves both the efficiency and output of the Halbach permanent magnet motor.

20259031 **Reducing Heavy Rare Earth Elements by Combining Permanent Magnets in IPM Motors**

Shunsuke Takahashi [1], Yutaka Sasaki [1]
([1]Hino Motors, Ltd.)

Abstract:
The technique of combining two types of magnets, referred to as the joined magnet, was investigated as a method to reduce the amount of heavy rare earth elements used in high coercivity magnets for IPM motors. In this approach, the magnets in the rotor were divided, and some parts were replaced with low coercivity (less heavy rare earth elements) magnets. It was found that motor performance, such as torque and efficiency, could be maintained. This technique suggests that simply replacing the magnets used in conventional motors can reduce the amount of heavy rare earth elements while maintaining demagnetization resistance and motor performance.

20259032 **A Study of Neodymium Magnet Replacement Technology for Electric Vehicle Traction Motor**

Kazuhiro Matsumura [1], Shunji Oki [1], Tomoaki Kaimori [1], Ryosuke Minegishi [1]
([1]Nissan Motor Co., Ltd.)

Abstract:
This paper studies the potential of using ferrite magnets as an alternative to neodymium magnets in motors for Electric Vehicles (EVs) to address the supply risks associated with neodymium magnets.

While ferrite magnets offer a stable supply, their lower magnetic flux density reduces torque density. In general, since torque of Interior Permanent Magnet Synchronous Motor (IPMSM) using ferrite magnets primarily depend on reluctance torque, this study specifically focuses on enhancing reluctance torque while maintaining the same level of magnetic torque as the conventional type. Parametric study based on FEA was conducted to optimize electromagnetic circuit design for improving reluctance torque. The proposed U-bar type design effectively mitigates both stress and magnetic saturation by dividing the second layer of magnets into three segments and achieved an increased torque by 7% without sacrificing magnetic torque.

20259033 **New Multi-Tooth Inter-Modular Flux Reversal Permanent Magnet Motor**

Mohammad Reza Sarshar [1], Mohammad Amin Jalali Kondelaji [2], Pedram Asef [2], Mojtaba Mirsalim [1]
([1]Amirkabir University of Technology (Tehran Polytechnic), [2]University College London)

Abstract:
This paper offers a new motor topology, multi-tooth inter-modular flux reversal permanent magnet (FRPM) motor, in which the PMs are positioned between the teeth of stator's wound pole (tooth PMs) and between the stator modules (inter-modular PMs). By using the motor's magnetic equivalent circuit, it is reported that the tooth PMs reduce the stator pole flux density while increasing the air-gap flux density. The motor specifications including dimensions are obtained by a multi-objective optimization using genetic algorithm. Two-dimensional finite element analysis is used to achieve the main operating characteristics in terms of flux density distributions, back-EMF, output torque, overload performance, and efficiency maps. Two benchmark inter-modular PM (IMPM) motors are studied as comparison criterion to highlight the achievements of the promising new motor topology. It is shown that the new structure improves the average torque by almost 45% compared to the benchmark IMPM while decreasing PM volume. Also, by examining the efficiency maps, the new motor topology indicates a 3.5 times larger high-efficiency area than its benchmark counterparts.

20259034 **Development of Low-Loss Technology Using Continuous Wave Winding**

Makoto Ito [1], Tetsuya Suto [1], Akeshi Takahashi [2]
([1]Hitachi, Ltd., [2]Astemo Ltd.)

Abstract:
We are developing a small and lightweight direct-drive system to realize in-wheel EVs. This drive system aims to improve the torque density of the motor by making the stator larger in diameter, thinner and flatter. In this paper, we will report on the concept of low-loss technology using a continuous wave winding structure with a flat sheet-piece coil. We analyzed the magnetic field effects between coils in a slot using FEA and quantified the effects of harmonic loss due to differences in coil layout. This analysis revealed that the loss reduction effect of continuous wave coils can be attributed to the coil space factor. A quantitative comparison of the space factor between a continuous wave coil and a conventional concentrated winding coil revealed that the continuous wave coil can reduce copper loss by approximately 10% compared to the conventional structure.

C12-PE **Automotive Power Electronics Technology 1**

Room C (14:35-16:15)

Chairs: Takashi Nozawa (TOYOTA MOTOR CORPORATION)
Tetsuya Kawashima (Hitachi, Ltd.)

20259035 **Finite Element Based Structural Validation of Printed Circuit Board Assemblies - Under Consideration of Static-, Vibrational- and Thermal Loads**

Neubacher Christian [1], Walter Hinterberger [1]
([1]MAGNA POWERTRAIN ENGINEERING CENTER STEYR GMBH & CO KG)

Abstract:
This paper presents automated simulation processes, which can time efficiently predict chip crack zones, vibrational failure of solder-joints and thermal stresses of printed circuit board assemblies (PCBA). Application in an early design phase can save additional design loops as well as physical testing and therefore reduces development costs.

Each investigation starts by creating a finite-element model of the whole PCBA, using suitable discretization through automated modeling techniques based on ECAD data.
For static and dynamic investigations, the simulation effort can dramatically be reduced by material homogenization without a significant loss of accuracy. Inclusion of all surface mounted devices (SMDs) as well as the solder-joints, which are modelled using different sub-modelling and sub-structuring techniques complete the method. The resulting PCBA model is then used to calculate chip crack zones or its dynamic behavior for vibrational fatigue evaluation of each solder-joint.
For thermal investigations a fine discretized PCBA including all layers, traces and vias of the PCB has to be used. With sub-modelling techniques one can assess a detailed thermal stress analysis of critical regions (e.g. plated through holes – PTH) in the PCB. Examples for the structural reliability analysis of PCBAs are presented, and how these processes benefit from FEA process automation. Finally, comparisons between measurement and simulation are shown.

20259036 **Functional Safety Assessment of High-Available 12V Power Supply Systems for Electric Vehicles with Automated Driving Functions**

Shouzheng Wang [1,2,3], Christian Winter [2], David Cello [1]
([1]Esslingen University, [2]Robert Bosch GmbH, [3]University of Stuttgart)

Abstract:
In recent years, significant progress has been made in the electrification and automation of vehicles. A highly reliable 12V power supply is a prerequisite for SAE Level 3+ automated electric vehicles, particularly for safety-critical functions. A so-called high-available 12V power supply system can guarantee a safe and uninterrupted 12V power supply for automated electric vehicles. One possible approach is to use redundant power sources, typically batteries. Alternatively, a DC-DC converter with high availability regarding the power supply can also be used, which is defined in this paper as a high-available DC-DC converter. This paper introduces the definition of high availability as well as high-available DC-DC converters and presents three different classifications of high-available 12V power supply systems for automated electric vehicles. Finally, the reliability and probabilistic metric for random hardware failures (PMHF) of each system are calculated to analyze functional safety in accordance with ISO 26262. Based on these results, the high-available 12V power supply system with the best reliability and functional safety performance can be identified.

20259037 **An Innovative Discrete-Time Model Considering Discretization Phase Error and Its Approximation Order Analysis for IM High-Speed Drive**

Zhifa Fang [1], Shinji Doki [1]
([1]Nagoya University)

Abstract:
Induction Motors (IMs) are widely used in electric vehicles (EVs) for their simplicity and reliability. The field-oriented control (FOC), which is required to achieve precise torque and swift speed control for EVs, can only be implemented discretely resulting in non-negligible discretization phase errors. This leads to undesirable voltage oscillations that severely deteriorate the current control performance or even disable the current loop as the fundamental-to-control frequency ratio (f_e / f_s) increases. Therefore, an innovative discrete-time IM model accurately modelling voltage oscillations is proposed. The auto current regulator (ACR) designed based on this model significantly enhances IM drive performance in high-speed range. Then, the discretization approximation error of the proposed model is analyzed. Eventually, simulations are conducted to verify the accuracy of the proposed model.

20259038 **Evaluation of Torque Feedback MTPA Control of IPMSMs Using Torque Estimation Map in the Magnetic Saturation and Regenerative Regions**

Haruka Tominaga [1], Keiichiro Kondo [1], Kazuhiko Matsunami [2]
([1]Waseda University, [2]Suzuki Motor Corporation)

Abstract:
Interior Permanent Magnet Synchronous Motors (IPMSMs) are widely applied to drive electric vehicles (EVs) because of their higher efficiency. In IPMSMs high currents cause magnetic saturation of the rotor core inductance fluctuations. Further, temperature changes in the permanent magnet of the rotor cause fluctuations in the electromotive force constant. Torque feedback maximum torque per ampere (MTPA) control, which seeks to achieve high-accuracy and low-loss torque control, necessitates accurate

torque estimation and MTPA angle calculation. Conventionally, the accuracy of this control strategy deteriorates because of the parameter fluctuations. In this study, the strategy was applied in conjunction with a torque estimation map that compensates for parameter variations in magnetic saturation and regenerative brake regions.

20259039 **A Modulation Method for Reducing DC-link Voltage Ripple in Open-end Winding Motor Drive Systems**

Kota Sato [1], Shinya Yano [1], Kenta Emori [1]
([1]Nissan Motor Co., Ltd.)

Abstract:
For motor drive systems used for open-end winding motors supplied by a dual-inverter configuration, this study proposes a modulation method that can reduce the DC-link voltage ripple by reducing the second harmonic component of the carrier frequency ($2f_c$ component) of the DC-link current (I_{dc_link}). The proposed method utilizes two triangular carrier waves, one shifted by 90° relative to the other, and selects the carrier wave used for the modulation of each phase according to the phase of the command voltage vector. Simulation results indicate that the proposed method can reduce the $2f_c$ component of I_{dc_link} by 77% compared to that achieved using the sinusoidal pulse-width modulation (SPWM) method, which uses the same carrier wave for all phases, under operating conditions that maximize the DC-link voltage ripple. The reduction effect of the I_{dc_link} is also validated by the experiment, indicating the usefulness of the proposed method.

A13-WPT **Electromagnetic Compatibility for Wireless Power Transfer**

Room A (16:30-17:50)

Chairs: Ryosuke Ota (Tokyo Metropolitan University)
Yukio Yokoi (Takushoku University)

20259040 **Novel Computational Approaches to Suppress Magnetic Field Leakage in Inductive Power Transfer Systems**

Yoshiaki Narusue [1], Daisuke Kobuchi [1], Hiroyuki Morikawa [1]
([1]The University of Tokyo)

Abstract:
Inductive power transfer (IPT) has been extensively studied as a promising technology for charging electric vehicles and mobile devices. This study focuses on novel computational approaches that help suppress magnetic field leakage in IPT systems. In particular, this manuscript presents an overview of (1) techniques for canceling magnetic field leakage, (2) Z-matrix estimation using phase retrieval, and (3) an automatic coil design algorithm. These approaches aim to suppress magnetic field leakage while reducing the cost of IPT systems and enhancing their transfer efficiency.

20259041 **Harmonic Current Control Method for Selective EMI Reduction in Electric Vehicle Wireless Power Transfer System**

Hyunsoo Lee [1], Seongho Woo [1], Sungryul Huh [1], Sanguk Lee [1], Jaewon Rhee [1], Changmin Lee [1], Seungyoung Ahn [1]
([1]Cho Chun Shik Graduate School of Mobility)

Abstract:
This paper proposes a method to selectively reduce electromagnetic interference (EMI) in an electric vehicle (EV) wireless power transfer (WPT) system. As power levels increase, it becomes more difficult to meet EMI limits, and specific harmonics that exceed these limits can cause problems in certain devices. In addition, additional shielding materials that increase the system's weight, volume, and cost should be used a lot to meet EMI limits. The proposed method presents an appropriate selection method of resonant circuit elements to adjust the harmonic currents, enabling the reduction of specific problematic harmonic without additional shielding materials. The proposed method was validated through simulation. Through the proposed method, it was confirmed that the 3rd, 5th, and 7th harmonics, which significantly exceed the EMI limits, can be reduced by 29.56 dB (3rd), 14.25 dB (5th), and 36.08 dB (7th), respectively.

20259042 **Numerical EMI Estimation of Active Implantable Medical Devices for EV Wireless Power Transfer Systems Based on Induced Electric Field and Current in the Human Body**

Takashi Hikage [1]
([1]Faculty of Information Science & Technology)

Abstract:
This study presents a numerical evaluation of electromagnetic interference (EMI) affecting implantable pacemakers exposed to an 85 kHz wireless power transfer (WPT) system for electric vehicle (EV) charging. A human torso phantom model was employed to estimate the interference voltage induced at the pacemaker terminals by analyzing the coupling of electric and magnetic fields through FEM analysis. Multiple exposure scenarios were investigated by varying the phantom's position and orientation relative to the WPT system. The proposed methodology provides a robust framework for assessing EMI risks under conservative conditions and contributes to the design of safer WPT environments for individuals with implantable medical devices.

20259043 **Standardization of Human Exposure Assessment for Low-Frequency (Below 30 MHz) WPT Systems (IEC/IEEE 63184)**

Keishi Miwa [1], Akihiko Nojima [1], Teruo Onishi [2]
([1]Toyota Motor Corporation, [2]National Institute of Information and Communications Technology)

Abstract:
Vehicle electronation has raised compliance concerns regarding the vehicle EMC performance below 30 MHz. One of the compliance concerns is the human exposure against the electromagnetic fields from electric vehicle (EV) which installs wireless power transfer system (WPT). The International Electrotechnical Commission (IEC) Technical Committee 106 (TC106), in collaboration with the Institute of Electrical and Electronics Engineers International Committee on Electromagnetic Safety (IEEE ICES) TC 34, published IEC/IEEE 63184, "Assessment Methods of the Human Exposure to Electric and Magnetic Fields from Wireless Power Transfer Systems – Models, Instrumentation, Measurement and Computational Methods and Procedures (Frequency Range of 3 kHz to 30 MHz)", in February 2025. This paper introduces the assessment method defined in IEC/IEEE 63184, using the exposure scenario of the WPT system which is installed on EV. It also presents a study on the spatial averaging method, as defined in IEC/IEEE 63184 for non-uniform exposure assessment, which was discussed during the standardization process.

B13-EP **Technology for In-wheel Motor**

Room B (16:30-17:50)

Chairs: Osamu Shimizu (The University of Tokyo)
Pedram Asef (Department of Mechanical Engineering University College London)

20259044 **Torque Control of In-Wheel Motor Electric Vehicles Using PI-like Continuous Sliding Mode Method**

Hiroyuki Fuse [1], Marius Heydrich [1], Valentin Ivanov [1], Tokikazu Mizuguchi [2], Yuna Morimoto [2], Binh-Minh Nguyen [2], Hiroshi Fujimoto [2]
([1]Technical University of Ilmenau, [2]The University of Tokyo)

Abstract:
Traction control plays a crucial role in the safety of vehicles. Therefore, it must have high reliability and robustness. In order to meet such demands, this study proposes a PI-like continuous sliding mode control (PI-CSMC) for the traction control of electric vehicles. First, this paper describes a PI-CSMC and the target vehicle model, which is equipped with in-wheel motors. Second, this paper shows that the wheel slip ratio can be alternatively controlled via wheel speed control. Consequently, the PI-CSMC can be utilized to implement the wheel speed controller. Finally, the slip ratio control is implemented on a real in-wheel-motor vehicle, and experiment of deceleration on slippery surface is demonstrated. The result suggests an effectiveness of the proposed PI-CSMC.

20259045 **Wheel Corner Design for Multi-actuated Electric Vehicles**

Viktar Skrickij [1], Paulius Kojis [2], Valentin Ivanov [1]
([1]Vilnius Gediminas Technical University, [2]Technical University of Ilmenau)

Abstract:
A wheel corner concept is proposed to realize more efficient and capable electric vehicle motion control. In this framework, each wheel is highly integrated and equipped with an in-wheel motor alongside multiple actuators, such as active suspension, active camber, active toe, and brake-by-wire system. This provides a high degree of freedom for controlling the vehicle dynamics, thus leading to higher redundancy and better fail-safety. The proposed chassis control is designed with the use of AI-based methods, contributing to software-defined vehicles capable of efficient, adaptive and predictive operation. The development process also includes an X-in-the-loop approach, where multiple digital twins, component hardware and test facilities are connected to a master hub and being operated in real-time, accelerating the development process and reducing the costs simultaneously. The proposed wheel corner concept aims for scalability and replicability to a wide range of vehicle segments.

20259046 **New Generation of IWM-corner Traction and Braking Power Density and Efficiency Roadmap**

Jurij Kern [1], Blaž Grafenauer [1], Martin Strojnik [1], Stefano Guerra [1], Gorazd Gotovac [1]
([1]Elaphe propulsion technologies, Inc.)

Abstract:
The research presented in the paper evaluates the potential improvements to the traction and braking power density and efficiency in an in-wheel corner. While today's in-wheel motors can be used in a variety of applications, there is still a significant potential for improvement through control, thermal management and integration. Increasing performance, without adding mass and cost, is an important aspect of this disruptive development and will not only be useful for the high-performance applications, but applies equally, with different optimization, to mass market IWM applications. While the current solution and near-term solutions significantly improve on the previous generation of in-wheel motors the research also shows a path to achieve the target of 55 Nm/kg and more than 95% average highway efficiency.

C13-PE **Automotive Power Electronics Technology 2**

Room C (16:30-17:50)

Chairs: Shinya Yano (Nissan Motor Co., Ltd.)
Tomohiro Fukazu (Honda R&D Co., Ltd.)

20259047 **A Capacitance Measurement Method for Power Modules in a Half-Bridge Topology for Automotive Applications**
- A Simple Capacitance Measurement Method for Power Modules -

Jaewon Rhee [1], Sanguk Lee [1], Changmin Lee [1], Hyunsoo Lee [1], Hongseok Kim [1], Jiseong Kim [1],Seungyoung Ahn [1]
([1]Korea Advanced Institute of Science and Technology)

Abstract:
This paper proposes a method for measuring the capacitance of power modules in inverters for vehicle motor drive applications. The capacitance of power modules can cause impedance changes in the current path, leading to switching noise. Therefore, an efficient measurement method is needed. Unlike the conventional multi-step measurement methods, a topology and a single-step measurement technique for extracting the capacitance of power modules is proposed. The capacitance between each terminal can be determined by performing S-parameter measurements on a 2-port network. The measured results are compared with datasheet values.

20259048 **Multi-port EV Charger Conducive to EV Society**
- Report on Large-scale Charging with Efficient Conversion System -

Kimihisa Furukawa [1], Yuichi Mabuchi [1], Daisuke Matsumoto [1], Hiroaki Miyata [2], Masaya Ichinose [2]
([1]Hitachi, Ltd., [2]Hitachi Industrial Products, Ltd.)

Abstract:
Various solutions are proposed to solve the issues for EVs society. We developed and released a multi-

port EV charger that can be applied for EV charging infrastructure to enable the effective use of energy in EV-based societies. In this paper, we will introduce features of the multi-port charger and an overview of the large-scale multi-port charging system that is currently being tested as one form of the multi-port EV charger, and also report on a technology for a high-efficiency isolated DC/DC converter, which is a core technology of the multi-port EV charger.

20259049 **PWM Control Method to Improve the Voltage Utilization Rate of the Inverter.**

Takeshi Kuroda [1], Takahiro Akahori [1], Taiga Sasaki [1], Akihiro Odaka [1]
([1]Fuji Electric Co., Ltd.)

Abstract:
Inverters that drive in-vehicle motors are required to be driven efficiently and stably in a wide operating range from low-speed large torque to high-speed high-induced voltage. In order to improve the efficiency of the inverter, it is necessary to further reduce the output current for the same torque by improving the voltage utilization rate. In this paper, we propose a PWM control method that improves the voltage utilization rate of the inverter, and confirm its effectiveness by experiments. In addition, the proposed method is compared with other control methods that realize 1-pulse, and points to be further improved in the proposed method are considered.

20259050 **Study of SiC Power Device Application for Various Electrified Vehicle**

Satoshi Yasuda [1], Keisuke Yuki [1], Ryoji Hironaka [1]
([1]Toyota Motor Corporation)

Abstract:
As part of its efforts to achieve carbon neutrality, Toyota offers a full lineup of electrified vehicles to its customers around the world, including battery electric (BEVs), hybrid electric (HEVs), plug-in hybrid electric (PHEVs), and fuel cell electric (FCEVs) vehicles as multi pathway approach. All these vehicles use power semiconductors to switch large currents on and off at high speeds. For this reason, power semiconductor performance has a major impact on vehicle power consumption efficiency, as well as the size and weight of powertrain components. SiC Power device is one of the promising devices for motor drive application. This article describes up-to-date example of SiC power device application for electrified vehicle and case study of comparison of advantage point by which inverter should be used.

Day 2 (Tuesday, May 20)

A21-WPT **Dynamic Wireless Power Transfer 1**

Room A (13:20-14:40)

Chairs: Keisuke Kusaka (Nagaoka University of Technology)
Ryosuke Ota (Tokyo Metropolitan University)

20259051 **Report on the 4-Year Burial of 41 Coils for Dynamic Wireless Power Transfer in Asphalt Roads**

Takehiro Imura [1], Takahiro Yamahara [1], Naoya Sasa [1], Yoichi Hori [1], Hiroki Tanaka [2], Nagato Abe [2]
([1]Tokyo University of Science, [2]Toa Road Corporation)

Abstract:
For dynamic wireless power transfer, the development of technology for embedding the coils in the road is important. In order to embed coils in the road, both electrical and mechanical properties are required. This study spans four years of embedding coils in asphalt roads on the Tokyo University of Science campus to evaluate their electrical and mechanical characteristics. A total of 41 coils were installed over a total length of 99.9 m. Adjustments to the design and installation methods were made to test performance. As a result, 20 of the coils installed in 2022 and 2023 met the required standards, including mechanical characteristics. An efficiency of 94% and an output equivalent to 50kW (calculated at an input voltage of 600V) were achieved, demonstrating successful development of a coil design and installation technique suitable for practical use.

20259052 **Proposal of Power Control Architecture of Dynamic Wireless Power Transfer for International Standardization**

Masato Maemura [1], Toshiya Hashimoto [1], Shogo Tsuge [1], Ryosuke Ikemura [1], Kazuyoshi Obayashi [2], Nobuhisa Yamaguchi [2], Keisuke Tani [2], Toshiyuki Fujita [3], Hiroshi Fujimoto [3]
([1]TOYOTA MOTOR CORPORATION, [2]DENSO CORPORATION, [3]The University of Tokyo)

Abstract:
This paper reviews the proposal for a power control architecture of Dynamic Wireless Power Transfer (DWPT) for international standardization. To ensure safe and reliable power supply during vehicle operation, it is essential for ground infrastructure to accurately assess the vehicle's power demands and execute activation for power delivery before commencing DWPT. Maximizing the power received by the vehicle enhances the commercial value of dynamic charging, but excessive power transfer may damage the battery. Therefore, this study focuses on activation methods utilizing 13.56MHz short-range communication within the DWPT system and battery protection through vehicle power control using active rectifiers. These technologies have been proposed by JARI as a Japanese initiative and incorporated into the International Electrotechnical Commission (IEC) Draft Publicly Available Specification (DPAS). Establishing an interface that facilitates coordination between ground-side infrastructure with regional characteristics and vehicle-side equipment is of utmost importance.

20259053 **Challenges of Electrical Road System (ERS) Towards DPWT**
- Load Durability of Non-contact Wireless Power Transfer Pavement -

Nagato Abe [1], Takahiro Yamahara [2], Naoya Sasa [2], Takehiro Imura [2], Yoichi Hori [2], Hiroki Tanaka [1]
([1]Toa Road Corporation, [2]Tokyo University of Science)

Abstract:
It is hoped that the introduction of electric vehicles will be promoted as a form of mobility that will help reduce CO2 emissions, a cause of global warming. To promote the introduction of EV vehicles, research is underway on Electrical Road System (ERS) in which DWPT coils that can supply power while driving are embedded in the pavement.
This paper summarizes the results of embedding magnetic resonance-type non-contact power transmission coils in the pavement, FEM model analysis, and running load tests using large vehicles.

B21-EP **Vehicle Motion and Stability Control**

Room B (13:20-14:40)

Chairs: Kantaro Yoshimoto (Tokyo Denki University)
Takeshi Kato (Honda R&D Co., Ltd.)

20259054 **Comparative Studies on the Performance of Antilock Braking System for a Hybrid Brake-by-wire System in EV Application**

Marius Heydrich [1], Valentin Ivanov [1]
([1]Thuringian Center of Innovation in Mobility, Smart Vehicle Systems)

Abstract:
This paper presents a case study on the performance of antilock braking system, especially tailored for use in electric vehicles with brake-by-wire system. In particular, a hybrid system layout with both, electrohydraulic and electromechanical brakes is discussed. Hence, the proposed controller and the control gains are adjusted accordingly to the different system dynamics. Within hardware-in-the-loop experiments on the real braking system, remarkable improvements about active safety and control robustness were achieved and evidenced through the assessment of objective performance indicators.

20259055 **Robust Roll Stability Control of Narrow Tilting Vehicle Based on Disturbance Observer**

Sunyeop Lee [1], Hyeonseok Cho [2], Kanghyun Nam [1]
([1]Yeungnam University, [2]Hyundai (Kia Namyang) Research and Development Center)

Abstract:
The automotive industry faces challenges like emission limits, traffic congestion, and limited parking demand for compact vehicles. However, the narrow design of these vehicles increases the risk of rollovers. This paper addresses rollover safety in Narrow Tilting Vehicles (NTVs), using the stability criterion of the Lateral Load Transfer Ratio (LTR). Detailed roll dynamics of an NTV with MacPherson strut suspension are presented. A cascade control structure with a robust position controller is proposed to enhance stability against disturbances. To validate the proposed tilting control strategy, a Hardware-in-the-loop (HIL) simulation was conducted, integrating a real-time vehicle simulator with CarSim to replicate roll dynamics under various driving conditions.

20259056 **Design of All-Speed-Range Electronic Differential System for Front-Wheel-Independent-Drive Electric Vehicles**

Bo-Chiuan Chen [1], Yen-Ju Huang [1], Shih-Hao Chen [1]
([1]National Taipei University of Technology)

Abstract:
An all-speed-range electronic differential system (EDS) based on steering geometry during yaw motion is proposed for electric vehicles with front-wheel-independent-drive architecture and no mechanical differential. The EDS primarily calculates the reference wheel speeds for each driving wheel based on the desired vehicle speed and the steering angle, and subsequently generates the required motor drive torques through a wheel speed controller. To maintain the same steering feel, a feedforward compensation control is designed and integrated into the electric power steering system to adjust the assisting torque. Simulation results show that the proposed EDS can enhance vehicle handling and driving stability in various test scenarios and vehicle speeds.

20259057 **Motor-Brake-Blending Based Roll Stability Enhancement for On Board Motor Electric Vehicles with Torque Vectoring Control**

Hiromitsu Toyota [1,2], Binh-Minh Nguyen [1], Sakahisa Nagai [1], Hiroshi Fujimoto [1], Kaoru Sawase [2]
([1]The University of Tokyo, [2]Mitsubishi Motors Corporation)

Abstract:
The importance of 6 Degree-of-Freedom (DOF) motion control using electric motors has increased with the shift from Internal Combustion Engine (ICE) Vehicle to Electric Vehicle (EV). There are two types of EV motors, one is In-Wheel-Motors (IWM) and the another is On-Board-Motor (OBM). Although OBM has been the mainstream for mass-produced vehicles, OBM-EV has a lower sprung posture control performance compared to IWM-EV. To overcome this issue, it is possible to integrate OBM with the Friction Brake Systems (FBS) that have the same sprung posture control effect as IWM. However,

FBS has lower response speed than that of OBM. This study proposes an OBM-FBS collaboration control method to increase the sprung posture stabilization during torque vectoring, thereby further resolving the phase shift issue between OBM and FBS. After presenting the theoretical framework of the proposed method, its control effectiveness is validated through real vehicle experiments.

C21-BAT **Application of Energy Storage System 1**

Room C (13:20-14:40)

Chairs: Kenji Natori (Chiba University)
Makoto Ogawa (Isuzu Advanced Engineering Center, Ltd)

20259058 **Bipolar Technology: The Next Step in Battery Volume Optimization**
- Opportunities and Challenges for New Vehicle Battery Platform Concepts -
Karsten Mueller [1], Michael Clauß [1], Alexander Fandakov [1], Marc Sens [1]
([1]IAV GmbH)

Abstract:
Despite significant advancements in the development of battery systems, which have enhanced volume utilization and vehicle range, sales in some regions are currently stagnating due to high prices and range anxiety. Over the past decade, IAV has been at the forefront of developing a compact bipolar Li-Ion battery system, designed to achieve driving ranges of up to 1000 km by integrating the battery directly into the vehicle chassis. The planar bipolar battery features plates with anodes and cathodes on opposite sides, connected in series to create a flat, space-efficient design. By eliminating the need for traditional module organization, this technology aims for high energy densities, low costs, and minimized internal resistance for improved efficiency. However, the bipolar concept also introduces unique technical challenges, such as the need for specialized electrical design and dedicated manufacturing equipment. This paper delves into the latest advancements in IAV's bipolar battery development, highlighting the potential for new platform concepts in vehicle applications.

20259059 **Parameter Identifications of Electrochemical NCA/SiOx Battery Cell Model Using Scaled Data from BEV Experiments**
Ratnak Sok [1], Jin Kusaka [1]
([1]Waseda University)

Abstract:
Not all Li-on cells have the same material properties, and the electrochemical cell model parameters (based on the DFN or P2D approach) cannot be used universally in different cells. The cell model must be calibrated before being scaled to a complete pack level for vehicle simulation. This work presents an approach to optimize the electrochemical NCA/SiOx Li-ion cell model under transient driving cycles. The cell data is scaled from a dual-motor, long-range Tesla Model Y experiment with a 75-kWh battery (Panasonic 21700 format cell). Multiple thermocouples were installed on the battery packs to measure brick-to-brick, module-to-module temperature for average data. Battery voltage, state-of-charge, and cooling data were recorded using OBD data. A total of 42 P2D cell parameters were reduced to 26 parameters using the Morris Method (aka Elementary Effect Method); then, the 26 parameters were optimized using the Genetic Algorithm optimization. Using the optimized 26 cell parameters, the cell and pack models could reasonably reproduce voltage, SOC, and temperature well under constant speed, WLTC, and FTP-HWFET cycles in winter and summer driving.

20259060 **Experimental and Numerical Study on Liquid Cooling Battery Thermal Management System for Battery Electric Vehicles**
- Analysis of Electrical and Coolant Parameters -
Maram Rihawi [1], Kamaleshwar Nandagopal [1], Ratnak Sok [1], Jin Kusaka [1]
([1]Waseda University)

Abstract:
Thermal management of lithium-ion battery modules is essential to prevent overheating and thermal runaway. This study analyzed the thermal and pressure responses of a liquid-cooled battery pack under varying discharge currents (150 A vs. 50A) and ambient temperatures (30°C vs. -5°C). Higher currents led to rapid temperature increases, requiring intensified cooling, while lower temperatures

reduced pressure stability, emphasizing the need for adaptable thermal management. A numerical model extended the experimental analysis by incorporating a refrigerant and cabin circuit into a validated coolant circuit. Under a constant discharge case at 12°C ambient temperature with 100 A, the numerical results showed that the cabin temperature increased from 12°C to 25°C within 800 seconds. This validated the system's effectiveness in maintaining optimal thermal conditions.

20259061 **Simulation of Battery Cell Heating Behavior Using a Thermal Model**

Hiroshi Hatakeyama [1], Shimpachi Matsunaga [1]
([1]Horiba, Ltd.)

Abstract:
A new thermal emulator that can simulate the heating behavior of real battery cells has been developed as a useful solution for the thermal management design of battery packs. The thermal emulator consists of a controller, a power supply, and a heater cell with the same shape as the real cell. The controller has a table of operating conditions obtained from the real cell and converts the operating conditions of the cell, such as current and initial SOC (State of Charge), into the operating current of the heater cell. The heater cell consists of a heater and thermal diffuser. Its structural design is based on a thermal network model that reproduces the thermal behavior of the real cell. The prototype thermal emulator simulates the surface temperature distribution of the real cell with an accuracy of ±2°C. By integrating this thermal emulator in a battery pack instead of real cells, thermal design and physical verification of the battery pack can be performed even if real cells are not available in the early stages of battery pack development.

A22-WPT **Dynamic Wireless Power Transfer 2 & Electric Drive Technology**

Room A (14:55-16:35)

Chairs: Yokoi Yukio (Takushoku University)
Takehiro Imura (Tokyo University of Science)

20259062 **Recent Developments for Wireless Electric Road Systems - Preparing the Breakthrough -**

Andreas Wendt [1], Oren Ezer [2], Elad Levi [2], Maximilian Kneidl [3]
([1]Electreon Germany GmbH, [2]Electreon Wireless LTD, [3]Seamless Energy Technologies GmbH)

Abstract:
The progress in dynamic wireless power transfer (D-WPT) led to the availability of wireless Electric Road Systems (wERS) that offer smart infrastructure solutions that can substantially reduce transport emissions and electric vehicle (EV) range anxiety. The basis of this technology is resonant Wireless Power Transfer (WPT), which was first demonstrated in the 1890s by Nikola Tesla and has since been developed for various applications. This paper illustrates the state of Electreon's wERS technology by insights from current pilot projects as well as progress from active R&D activities.

20259063 **Verification of Big Data Analysis on Dynamic Wireless Power Transfer for Electric Vehicles Focused on Traffic Signal GPS**

Yutaka Shikauchi [1], Kota Fujimoto [1], Osamu Shimizu [1], Hiroshi Fujimoto [1], Shuji Kawano [2]
([1]The University of Tokyo, [2]Honda R&D Co., Ltd.)

Abstract:
Dynamic wireless power transfer (DWPT) system primarily consists of transmitter coils embedded in the road to send power and receiver coils installed in electric vehicles (EVs) to receive power. By utilizing the DWPT system, EVs can receive power while driving, which is expected to improve driving range and reduce the battery capacity required. However, studies specifically focus on the potential of DWPT to reduce battery capacity is limited. Previous studies have analyzed the minimum battery capacity required for EVs under the assumption that DWPT is conducted when vehicles are stationary and the brake is applied, with a focus on vehicles operating on general roads. However, this analysis did not consider conditions related to intersections, and it did not ensure that the vehicles were indeed stopped. In this paper, we conduct an analysis using the GPS data of vehicles traveling on general roads in Kashiwa city and traffic signal GPS information. We analyze the ratio of DWPT conducted per drive cycle under the condition that power transfer occurs when a vehicle is within 30 m of a traffic signal, and we compare these results with those of previous study.

20259064 **Trade-offs between WPT Infrastructure Investment and EV Investment Towards Infinite Driving**

Yudai Honma [1], Daisuke Hasegawa [1], Katsuhiro Hata [2], Takashi Oguchi [1]
([1]The University of Tokyo, [2]College of Engineering, Shibaura Institute of Technology)

Abstract:
In-motion Wireless Power Transfer Systems (WPTS) are increasingly seen as critical infrastructure to support electric vehicle (EV) mobility, especially in achieving the concept of "Infinite Driving." This study examines the trade-offs between WPTS infrastructure investment and EV battery capacity requirements by analyzing optimal WPTS locations in urban areas. By simulating EV charging and discharging patterns with considerations for acceleration, deceleration, and traffic signals, this research assesses the required battery capacity for urban EV travel. Findings highlight that strategically located WPTS can significantly reduce battery capacity requirements, demonstrating the potential of WPTS to complement EV investments and support sustainable urban mobility.

20259065 **Charging Ahead**
- Optimal Location of Wireless Power Transfer Systems to Electrify Roads in Urban Environments -

Thomas Byrne [1], Yudai Honma [2]
([1]University of Strathclyde, [2]The University of Tokyo)

Abstract:
The popularization of electric vehicles (EVs) is limited by their driving range and long charging times. To address this, in-motion charging solutions are currently attracting attention as a new power supply system. In-motion charging infrastructure such as wireless power transfer systems (WPTSs) have coils embedded under the road to transfer power from the WPTSs to EVs while driving. However, the main drawback of this technology is their large investment, especially in supporting the long-distance trips of EVs on expressways. Therefore, this study proposes new models for determining the optimal location of in-motion charging infrastructure for maximized total feasible flow demand or minimised external power requirements for the entire system. We observe that in-motion charging has strong potential as an EV power supply system in terms of coverage and economic rationality. In particular, in-motion charging has economic rationality not only in busy networks but also in sparsely populated networks that connect urban and rural areas. Thus, this study clarifies the important insights of in-motion charging infrastructure planning in improving their effectivity to narrow down the demand and ensure the flexibility in the locations of implementations of this technology.

B22-MOT **Motor Drive Technologies**

Room B (14:55-16:35)

Chairs: Shota Hanioka (Mitsubishi Electric Corporation)
Kantaro Yoshimoto (Tokyo Denki University)

20259066 **Comparative Analysis of Modulation Methods for High-Speed, Low-Inductance Motors**

Keitaro Kawarazaki [1], Taiki Mikami [1], Yuichiro Deguchi [1], Sho Morita [1], Nobukazu Hoshi [1]
([1]Tokyo University of Science)

Abstract:
This paper examines the impact of modulation methods on the performance characteristics of high-speed and low-inductance motors. Specifically, the attributes of SVPWM (noted for low current ripple), MLDPWM (effective for reducing switching loss), and RSPWM (for suppressing common-mode noise) are compared through simulation for the modulation method. Inverter efficiency maps and current THD maps for rotational speeds up to approximately 50000 min^{-1} were analyzed across these modulation methods. Simulations have revealed clear performance differences among the modulation methods regarding current ripple, inverter efficiency, and common-mode noise for high-speed, low-inductance motor applications.

20259067 **Current Harmonics Suppression Control for EV Traction Motor - Development of EV Traction Motor Control -**

Wataru Hatsuse [1], Toshiyuki Ajima [1]
([1]Hitachi, Ltd.)

Abstract:
In recent years, motor-powered automobiles such as hybrid cars, plug-in hybrid vehicles, and electric vehicles have been attracting attention due to growing interest in environmental issues. To further expand the interior space and battery loading capacity of electric vehicles, consideration is underway to increase power density. In this paper, we propose current harmonics control that suppresses current harmonics for high power density. Specifically, we constructed a harmonic voltage model and an optimization environment using harmonic currents as the objective function. As a result, the effectiveness of the harmonic voltage model was confirmed with the actual machine. In addition, it was confirmed with simulation that the current harmonics control suppresses the harmonic current component.

20259068 **Development of Five-Phase Multi-Mode Reluctance Motor with Current Vector Control for xEV Application**

Ryo Kokubu [1], Kyohei Kiyota [1]
([1]Institute of Science Tokyo)

Abstract:
Multi-Mode Reluctance Motor (MRM) represents an innovative technology for sustainable non-rare-earth motors. MRMs improve performance through transitions between high-efficiency SynRM and high-power SRM modes. MRMs also require only the minimal current control freedom equivalent to the number of motor phases and minimize the cost increase associated with the drive circuit. This paper discusses the theoretical derivation and potential application of current vector control for a five-phase MRM. This paper also presents case studies on torque control and design optimization of a 12-pole 20-slot 5-phase MRM for the traction motor of xEVs.

20259069 **Motor Current Control for High Speed Motor Drive Systems**

Kantaro Yoshimoto [1], Yuto Hirao [1], Tomoki Yokoyama [1]
([1]Tokyo Denki University)

Abstract:
This study examines the challenges of controlling the motor currents in low-inductance motors for high-speed motor drive systems. To achieve a compact motor design with a high-speed motor, the stator could be designed with low-inductance due to a reduced number of turns or a coreless structure. Simulation results indicate that the large current ripple causes the motor current control error in conventional vector control used for PMSMs with the current sampling technique synchronized to PWM. Through the analysis of the motor current control errors, a multi-sampling current control strategy is considered to address the motor current control errors.

20259070 **Development of High Voltage Insulation of the Motor for BEVs, HEVs and PHEVs**

Noriyoshi Yamada [1], Junichi Deguchi [1], Eiji Yanagida [1], Keiji Takizawa [1], Masahito Shirahase [2], Norihito Kimura [2]
([1]TOYOTA MOTOR CORPORATION, [2]SOKEN, INC.)

Abstract:
In automotive motors, high voltage driving has become the mainstream approach to achieve high output and compactness. Meanwhile, in terms of structure, motors that use rectangular coil wires are becoming more prevalent compared to those that use round wires. Given this background, capturing the differences in surge voltage due to changes in motor structure is crucial to enhancing insulation reliability. This paper examines the characteristics of surge voltage in motors with rectangular coil windings. Additionally, it presents the surge analysis results of high-voltage motors using rectangular coil wires obtained through surge voltage prediction technology developed in-house, and compares those results with actual measured values.

C22-BAT **Application of Energy Storage System 2**

Room C (14:55-16:35)

Chairs: Daichi Imamura (JARI)
Ratnak Sok (Waseda University)

20259071 **Improving Battery Pack Model Accuracy of Next-generation Light-duty Battery Electric Trucks under JE05 Driving Cycle**
- Lookup Table Generated from an Electrochemical Cell Model with Temperature Consideration -

Xinwei Li [1], Haoxiang Li [1], Ratnak Sok [1], Keiki Tanabe [2], Goro Iijima [2], Jin Kusaka [1]
([1]Propulsion and Energy Systems Laboratory, [2]Mitsubishi FUSO Truck & Bus Corporation)

Abstract:
This paper proposes an electrochemical battery model for electric trucks, incorporating temperature effects to enhance simulation accuracy. The proposed model is compared with the conventional Internal Resistance (IR) look-up model to evaluate performance improvements. With its more detailed representation of battery dynamics, the electrochemical model, particularly under varying thermal conditions, demonstrates a higher prediction accuracy. Simulation results under JE05 driving conditions show that the proposed model improves the accuracy of voltage prediction, offering a more reliable tool for electric truck powertrain simulations.

20259072 **Simulation of Electric Mobility Concepts**
- Swappable Batteries and Battery Swapping Stations -

Sebastian Brulin [1], Tamon Toyooka [2], Lydia Fischer [1], Tobias Rodemann [1], Florian Kreuchauff [3]
([1]Honda Research Institute Europe, [2]Institute of Science Tokyo, [3]Honda R&D Europe)

Abstract:
This paper investigates the comparative performance of swappable battery electric vehicles (SBEV) with battery swapping stations (BSS) and electric vehicles (BEV) with stationary charging stations (CS) in an urban traffic scenario using the large-scale activity-based simulator MATSim on the city of Hamburg, Germany, to assess user behavior across various EV system specifications. Focusing on user experience and operational efficiency, we hypothesize that BSSs offer shorter charging times for users compared to CS. Key variables under investigation include charging speed, battery capacity, number of battery sockets per vehicle, and charging capacity per station. A primary objective is to identify critical break-even points at which one infrastructure type demonstrates improved performance over the other, providing insights into optimal deployment strategies regarding station density and product specifications. These findings aim to support operators in making data-driven decisions on electric vehicle infrastructure, contributing to efficient urban mobility systems.

20259073 **Application of Battery Digital Twin to Charge Planning Problem for a Fleet of Electric Vehicles**

Subhajeet Rath [1], Alenka Beckers [1], Paul Netto [1], Robinson Medina [1], Steven Wilkins [1,2]
([1]TNO, Dept. of Powertrains, [2]Eindhoven University of Technology)

Abstract:
The transition towards vehicle electrification presents various challenges due to uncertainties in charging behavior and battery aging. This study proposes a strategy to generate a charging schedule for a Battery Electric Vehicles (BEVs) fleet to reduce the Total Cost of Operation (TCO). Battery Digital Twins (DTs) are used to improve the standard scheduling strategy, which provides a realistic assessment of battery aging, grid load, and charging time. The DTs are adaptive, have fast prediction and have low training costs. The method is virtually tested to show the improvements in scheduling while using the DTs.

20259074 **AI Driven Digital Twin for Improved Battery Performance and Predictive Maintenance**
- From Data to Insights for Faster Engineering Decisions -

Nikolaus Keuth [1], Gerhard Schagerl [1]
([1]AVL List GmbH.)

Abstract:
The automotive industry faces significant challenges in managing warranty claims, particularly those related to battery safety in electric vehicles. In 2022 alone, the industry paid $43.1 billion in claims, with a notable portion attributed to battery-related issues. This presentation introduces an AI-powered Digital Twin technology designed to improve battery safety and reduce warranty costs. The Digital Twin leverages data from development, telematics, and in-vehicle usage to provide accurate state-of-health (SOH) monitoring and prediction, anomaly detection, and range optimization. Key benefits include a 97% identification rate of battery issues one month before occurrence, a 92% reduction in recall volume, and three times more accurate range predictions. A reference architecture of the Battery Digital Twin is described, its scalable analytics backend, and the application of machine learning methods for continuous improvement of battery management systems (BMS). This innovative approach not only enhances battery performance and safety but also contributes to sustainable mobility by optimizing operational efficiency and reducing total cost of ownership (TCO)

20259075 **Battery Diagnostics and Monitoring Methods**
- A Comparative Analysis of Active Versus Passive Approaches–
Avedis Dadikozyan [1], Camiel Beckers [1], Tim Meulenbroeks [1,2], Erik van den Tillaart [1], Steven Wilkins [1,2]
([1]Powertrains Dept, [2]Eindhoven University of Technology)

Abstract:
The rapid uptake of lithium-ion battery use across transport and energy storage applications increases the relevancy and the need for diagnostics and monitoring methods to ensure safety, reliability, and longevity. This paper presents a comparative study of passive and active battery diagnostic methodologies, focusing on their applications in real-world scenarios. Passive diagnostics utilize battery signals occurring during real-world use, offering a non-intrusive, cost-effective solution suitable for applications requiring minimal intervention, such as battery passports and large fleet monitoring. In contrast, active diagnostics employ controlled signals to gain deeper insights into the battery state, enabling precise tracking of degradation and early fault detection. Our study reviews implementations of these active system identification approaches, including Battery Management System (BMS)-integrated solutions and use of various cloud-based methods across European and Dutch projects. We examine the technical challenges of each diagnostic approach and provide a qualitative comparison between the two.

A23-WPT **Other Applications for Wireless Power Transfer**

Room A (16:50-17:50)

Chairs: Minoru Okada (Nara Institute of Science and Technology)
Katsuhiro Hata (Shibaura Institute of Technology)

20259076 **A Waveguide Power Transfer for Electric Vehicles in Motion**
Yuichi Masuda [1,2], Naoya Takahashi [3], Katsuhiro Hata [3], Hiroyuki Shinoda [1]
([1]The University of Tokyo, [2]2DC, Inc., [3]Shibaura Institute of Technology)

Abstract:
We propose a waveguide power transfer system for electric vehicles (EVs) in motion. In conventional wireless power transfer systems using magnetic coupling, the coupling coefficient tends to decrease due to flux leakage, which limits the positional flexibility of the receiver. The proposed system addresses this limitation by significantly reducing the group velocity in a waveguide sheet, allowing for strong magnetic coupling to be maintained regardless of the waveguide sheet length. We introduce a theoretical framework that considers three critical areas: propagation, coupling, and termination. Experimental results at 85 kHz confirmed wave propagation characteristics, achieving maximum power transfer efficiencies of approximately 86 %.

20259077 **Latest Trends in Rulemaking for Capacitive Coupling Wireless Power Transmission Systems Using 6.7MHz Frequency Band**
Kunihiko Sasaki [1], Tetsuo Endo [2], Masahiro Hanazawa [2], Shinji Abe [3]
([1]Nagoya Institute of Technology, [2]TAISEI CORPORATION, [3]Power Wave Co., Ltd.)

Abstract:

As the Broadband Wireless Forum (BWF), a standardization organization for radio systems, we have participated in the Wireless Power Transmission (WPT) Working Group of the Radio Environment Committee of the Information and Communications Council of the Ministry of Internal Affairs and Communications of Japan since 2020. We have been deliberating on the institutionalization of Capacitive (or electric field) Coupling Wireless Power Transmission Systems (CC-WPT) Using 6.7MHz Frequency Band for AGVs and AMRs under the Radio Act. In May 2024, the results of the research to determine the technical conditions were put out for public comment, and submitted to the Minister of Internal Affairs and Communications in June 2024. In response to this report, the Ministry of Internal Affairs and Communications prepared a draft amendment to the regulations related to the Radio Act, which was then submitted to the public for comment in October 2024. The amendment was revised and enacted as a Ministry of Internal Affairs and Communications Ordinance in December 2024. This article explains the technical discussions in the institutionalization of the Radio Act.

20259078 **Toward Extension of Undersea EM Field Propagation Distance**

Ikuo Awai [1], Takashi Ohira [1], Shunsuke Hino [2], Hiroki Shigetomi [2], Masayuki Okamoto [2], Yoshiki Mizukami [3]
([1]Fujiwaves Co. LTD., [2]Ube College, [3]Yamaguchi University)

Abstract:
The present paper shows that one could realize the effective power delivery to the sailing ships on the sea by shielding the power transferring electrodes properly. In addition, it is trying to clarify the origin of transmission loss of EM field in the seawater based on the general kQ theory. The theory can predict the wave transmission efficiency in the seawater directly from the measured S parameters, irrespective of non-propagating (near) field or propagating (far) field. Thus, it would predict that there could be some low loss frequency band in the seawater.

B23-MOT **Motor Technologies**

Room B (16:50-17:50)

Chairs: Shingo Soma (Honda R&D Co., Ltd.)
Kohei Aiso (Shibaura Institute of Technology)

20259079 **Applying the Drive Shaft Torsional Vibration Control to Induction Motors**

Kohei Kawasaki [1], Sho Ohno [1], Hiroyuki Komatsu [1], Yui Ito [1], Akira Sawada [1], Takashi Nakajima [1]
([1]Nissan Motor Co., Ltd.)

Abstract:
The authors have been developing torsional vibration control for electric vehicles using IPMSM, but it contains rare-earth. While induction motors are one of the rare-earth-less motors, a phase delay of the rotor magnetic flux exists with respect to the stator current. Due to this phase delay, the response of the actual torque to the torque command value exhibits nonlinear characteristics, and a sufficient vibration suppression effect cannot be obtained with the conventional control. In this paper, the authors propose a new torsional vibration control for induction motors and confirm that a smooth acceleration response can be realized through simulations and vehicle experiments.

20259080 **Energy Management Strategy for Dual IM-PMSM Electric Vehicles**

An-Toan Nguyen [1,4], Binh-Minh Nguyen [2], João Pedro F. Trovão [1,3], Minh C. Ta [1]
([1]Université de Sherbrooke, [2]The University of Tokyo, [3]Polytechnic of Coimbra, [4]Faculty of Engineering and Technology)

Abstract:
This paper proposes a model-based control system to extend the range of dual-motor all-wheel-drive electric vehicles (EVs) across various electric motor (EM) configurations. By analyzing the dynamics of EMs, wheels, and chassis, a cost function is formulated to minimize input power, taking into account driving force distribution and motor current. An optimal strategy for driving force and EM current distribution is developed for real-time implementation on conventional EV electronic control units. Computer simulations demonstrate the effectiveness of this strategy in both constant speed and dynamic driving scenarios.

20259081 **Potential for Improving Motor Performance Using Thermosetting Molding Materials**

Shinya Yamamoto [1], Hirofumi Kuroda [1], Takahiro Harada [1], Wataru Kosaka [1], Atsunori Nishikawa [1]
([1]SUMITOMO BAKELITE CO., LTD.)

Abstract:
This paper presents an effort to realize motor that lead to high efficiency & high performance by applying various plastic materials as solutions for motor in the trend of promoting EV. We have confirmed that it is possible to reduce stator coil temperature, and motor NV by applying a water channel in the slot with stator coil encapsulation, and a Phenolic housing.

Day 3 (Wednesday, May 21)

A31 Grid & Charging Technology

Room A (13:20-14:20)

Chairs: Kenji Natori (Chiba University)
Katsuhiro Hata (Shibaura Institute of Technology)

20259082 **Reduction of grid electricity demand of BEV's by applying integrated photovoltaics - A modelling approach -**

Lenneke Slooff[1], Anna J. Carr[1], Ashish Binani[1], Oscar van de Water[1], Michiel Zult[2], Akshay Bhoraskar[2], René van Gijlswijk[2]
([1]TNO – Energy and Materials Transition, [2]TNO – Mobility and Built Environment)

Abstract:
In this paper we calculate the amount of energy that can be generated by applying vehicle integrated photovoltaics (VIPV). The amount of energy not only depends on the type of vehicle, availability of the area that can be used for integrated photovoltaics, but also in the driving profile, or the way the vehicle is used. For this reason first the typical driving profiles of the different vehicle types were defined and typical driving profiles were generated for the different vehicle types. Then the generated energy was calculated for two different locations, namely Amsterdam and Madrid and compared to the energy demand of the vehicle for that specific driving profile.
In total a series of 24 representative driving profile and vehicle combinations have been assessed through simulations using TNO's Energy Flow Model(1), which include passenger cars, small and large vans, buses and trucks.
The results were compared with other energy reduction options such as improved aerodynamics, lower rolling resistant tires, LED lighting etc. We show that the addition of PV to the vehicles can have significant impact on the overall energy consumption, especially when combined with other vehicle efficiency improvements.

20259083 **Impact of Electricity Prices and Tariffs on Smart Charging: A Comparison Between Norway and Denmark Using Receding Horizon Optimization**

Anna Malkova[1], Jan Martin Zepter[1], Magnus Korpås[2], Mattia Marinelli[1]
([1]Technical University of Denmark, [2]Norwegian University)

Abstract:
With the growing number of electric vehicles (EVs) in Denmark and Norway, the need for efficient control of charging stations increases. This paper compares smart charging strategies using a receding horizon optimization method, focusing on the different electricity pricing systems in both countries. By optimizing EV charging based on hourly electricity prices, we aim to reduce costs for charging point operators (CPOs). The results show that being a CPO in Norway is 1.4 times more profitable in terms of operational costs than in Denmark, with on average 1116 € more profit for Norway per year in more favorable scenario with high energy delivery rate for EVs.

20259084 **Evaluating 48 V and New Architectures for the Low Voltage Power Supply**

Richard Weldle[1], Takuya Mimori[1]
([1]Schaeffler AG)

Abstract:
The paper addresses the recently renewed discussion about the introduction of 48 V as the main voltage level for power distribution in the automotive low voltage (LV) network beyond mild hybrid functionality. Tesla introduced 48 V power distribution in the Cybertruck in 2023, so far being the only OEM (Original Equipment Manufacturer) taking this step and advocates a 48 V standardization. Most OEMs have however, not changed yet to a 48 V power supply, despite the obvious advantages in power capability, and the predicted weight and cost savings. Among other factors, the large legacy effect of the long established 12 V applications as well as high initial investments for a redevelopment of commodity components have kept OEMs from increasing the main LV level to 48 V. But as new technologies and functions are introduced into modern vehicles, the limitations of a 12 V based power supply is becoming an obstacle that is hard to overcome without supersizing the existing power supply

and its underlying architecture beyond a reasonable degree. A new potential trigger point is the adoption of 48 V in conjunction with an introduction of zonal architectures. The goal is a simplification of the complex wiring harness and enabling the supply network to power new vehicle features which demand a high-power capability on LV level and often have increased requirements in terms of availability and robustness of the supply. Currently, a lot of uncertainty remains about the if, when, and for which vehicle segments, equipment and markets, such a major step is technically as well as financially feasible. The final conference contribution will cover several aspects of this many-faceted discussion, give some background information on the ongoing efforts in adjusting the regulatory framework, and shed some light on enablers as well as potential pitfalls for the transition to a 48 V power supply. System simulation will be presented as the tool of choice to evaluate technical aspects and to prove the validity of new supply concepts in an early stage.

B31-BAT **Energy Storage System Technologies**

Room B (13:20-14:20)

Chairs: Noriko Yoshizawa (National Institute of Advanced Industrial Science and Technology)
Kazuhito Kishi (RICOH Co., Ltd.)

20259085 **Ultrafast Charging for Different Applications with SuperBatteries and Supercapacitors**

Linus Froboese [1], Viviana Piccinni [1]
([1]Skeleton Technologies GmbH)

Abstract:
Supercapacitors and SuperBatteries have experienced an evolution over the last years. Supercapacitors reach up to 16 Wh/kg and 60 kW/kg whereas SuperBatteries reach 65 Wh/kg and 4 kW/kg, outperforming every lithium-ion battery and lithium capacitor in terms of power but also cycle life (1,000,000 cycles for supercapacitors and 50,000 cycles for SuperBatteries). These unique properties are only achievable by utilizing a unique active material called curved graphene. Skeleton achieves superior power density and durability while eliminating the need for cobalt, copper, nickel, or graphite. This unique technology allows a variety of automotive applications, which were not possible before: power backup units for trucks providing 600A for six minutes out of a 24V battery; ultra-fast charging energy recovery in racecars allowing to recharge the whole system in just 4 s; emission reduction in vocational trucks with opportunity charging with 300kW in less than 6 minutes; on-board net stabilization for safer and longer-lasting primary batteries through supercapacitor support. Supercapacitors and SuperBatteries are poised to drive innovation in energy storage, offering safer, more efficient, and environmentally friendly alternatives to conventional lithium-ion batteries.

20259086 **Diagnosis Technology for Lithium Ion Battery Degradation**
- A Battery Pack of EV Can Be Analyzed by Square-wave Current EIS -

Shun Egusa [1,2], Tetsuya Osaka [2], Toshiyuki Momma [1]
([1]Research Organization of Nano & Life Innovation, Waseda University, [2]EC SENSING, Inc.)

Abstract:
Electrochemical impedance spectroscopic (EIS) analysis is used as the most effective tool in the design and development process of batteries and the related materials. However, its weak-point is the long measurement time, making it difficult to apply to operational battery systems such as Electric Vehicle (EV) and Stational Battery Storage System (BESS). We have developed a square- current wave EIS method, which has succeeded in shortening the measurement time by 1/10. Furthermore, by generating a square- current wave using an inverter installed into a quick charger, we have succeeded in detecting the internal impedance of EVs.

20259087 **Analysis of Influencing Factors of Electric Bus Energy Consumption**

Xiaopan Li [1], Baoku Zhang [1], Chongshan Yang [1], Hua Shi [2]
([1]Jiangsu Alfa Bus Corporation, [2]Shanghai ECAR New Energy Vehicles Technology Corporation)

Abstract:
With the continuous improvement of environmental awareness and the rapid development of new energy technology, electric buses are playing a more and more important role in urban transportation. In

this paper, the influence factors of electric bus energy consumption are deeply studied, including vehicle characteristics, driving conditions, driving behavior and environmental factors. Through the analysis of the actual running data and the experimental research, the specific influence mechanism of these factors on the energy consumption of electric buses is revealed. On this basis, the effective measures and suggestions to reduce the energy consumption of electric buses are put forward, which provides theoretical basis and practical guidance for improving the energy utilization efficiency of electric buses and promoting the sustainable development of urban public transportation.

20259088 **The Role of Mg in the Circular Economy and its Potential as an Energy Carrier -Agriculture (Forestry), Fishery and Modern Industry-**

Hiroyuki Shibata [1], Michiru Sakamoto [2], Shiori Kumagai [2], Masahiko Maeda [2]
([1]Tohoku University, [2]The Council of Circulating Society, Sendai)

Abstract:
The biggest challenge we face today is to sustainably produce and consume energy to sustain society. For example, it is an urgent issue to find a way to develop the use of magnesium (Mg) as a new energy carrier. Mg has the potential to achieve true material circulation by smelting Mg using renewable energy or surplus energy, using it as an electrode in batteries, and smelting it again from the used compound. It is thought that Mg can be regarded as a truly circulatable energy carrier, and by building it as a sustainable energy circulation system and making it a technology that can be used equitably anywhere in the world, it will contribute to the preservation of the global environment.
It can be said that our efforts have a high affinity with the concept of the circular economy, which is a global trend.

C31-FC **Fuel Cell Technology 1**

Room C (13:20-14:20)

Chairs: Shohji Tsushima (Osaka University)
Kotaro Ikeda (TOYOTA MOTOR CORPORATION)

20259089 **Carbon Monoxide Poisoning and Recovery on a Polymer Electrolyte Fuel Cell with a Hydrogen Circulation System**

Yoshiyuki Matsuda [1], Takahiro Shimizu [1], Daichi Imamura [1]
([1]Japan Automobile Research Institute)

Abstract:
The impact of carbon monoxide (CO) on fuel cell performance was systematically investigated under varying operating conditions or electrolyte membrane thickness in a single-cell evaluation system equipped with a hydrogen circulation system typically applied in fuel cell vehicles. Among the effects of various parameters, including cell temperature, CO concentration, fuel stoichiometry, and electrolyte membrane thickness, the influence of cell temperature and CO concentration was found to be significant. The voltage in the presence of CO (0.2 ppm) at a constant current of 1.0 A cm^{-2} did not decrease at 80 °C of the cell temperature, whereas a large voltage drop was observed at 40 °C, probably due to a decrease in the CO oxidation rate at the anode. Meanwhile, the voltage at 1.0 A cm^{-2} significantly recovered even at 40 °C after load cycles between 0.025 and 1.0 A cm^{-2}. The voltage recovery was attributed to (i) the accumulation of permeated oxygen from the cathode in the hydrogen circulation system, and (ii) the reduction in the CO supply rate because load cycles were applied to a lower current density. These effects probably led to a smaller CO-to-oxygen ratio and enhanced CO oxidation.

20259090 **Verification of a Novel Hydrogen Refueling Method for HDVs - Significant Reduction for Refueling Time and Hydrogen Pressure Storage Volume -**

Kiyoshi Handa [1], Tatsuya Rembutsu [2], Tomonari Komiyama [3]
([1]HONDA R&D Co., Ltd., [2]Tokico System Solutions, Ltd., [3]HySUT)

Abstract:
Current hydrogen stations for passenger FCV are using a constant dispenser hydrogen pressure ramp rate method. When a hydrogen flow rate increases for heavy duty vehicle, a large pressure loss occur and it slows down refueling. To compensate for this tube pressure loss without any feedback from the

vehicle, a novel method (cTPR method) which has the hydrogen constant pressure ramp rate in the vehicle tank was developed. A refueling testing with cTPR method at full commercial scale confirmed that a refueling time can be shortened. cTPR makes it possible to use the pressure storage capacity for hydrogen more efficiently and to reduce the number or volume of pressure storage tanks. cTPR can also help to reduce the cost of building and operating refueling stations.

20259091 **Development of a New Structural Fuel Cell and Stack**

Manabu Iwaida [1], Choichi Ishikawa [1], Takashi Kato [1], Kazuo Nunokawa [1]
([1]Honda R&D Co., Ltd.)

Abstract:
The newly developed structural fuel cell stack for fuel cell vehicles achieves more than twice the durability and one-third the cost of previous fuel cell stacks while maintaining their basic performance. To improve the durability of the fuel cell stack, we controlled the operating environment, improved the electrolyte membrane durability by reducing iron elution from the bipolar plates, and suppressed the degradation of the catalyst by specifying the contact angle of the bipolar plate to mitigate unstable power generation. To reduce the cost of the fuel cell stack, we achieved the same net power as the previous fuel cell system with fewer cell stacks. Major cost reductions include the use of metal beads for the sealing structure of the bipolar plate, adopting a rubber coating-less structure, applying Pt alloys to the electrode catalyst of the Unitized Electrode Assembly to reduce the amount of Pt, and reducing the thickness of the electrolyte membrane.

20259092 **Approach to Building Technology for Mass Production of Fuel Cell Systems for Social Implementation -**

Hiroaki Kawanishi [1], Yusuke Wada [1], Keita Iwaya [1]
([1]HONDA R&D Co., Ltd.)

Abstract:
In this paper, we developed trimming technology, stack load control technology, and segmented electrical shorting inspection technology to achieve the goals of miniaturization, high output, improved durability, and cost reduction in the development of automotive fuel cell systems. This allows for the high utilization of expensive materials without waste, contributing to the establishment of mass production processes for promoting the social implementation of fuel cells.

A32 **Advanced Simulation & Measurement Technology**

Room A (14:55-16:35)

Chairs: Hiroya Sugimoto (Tokyo Denki University)
Osamu Shimizu (The University of Tokyo)

20259093 **Standardisation of Hardware Protected Security Environments GlobalPlatform Alignment with SAE's J3101: An Opportunity for Japanese Standardisation Alignment**

Francesca Forestieri [1], Gil Bernabeu [1]
([1]GlobalPlatform)

Abstract:
Standardisation alignment on hardware protected security environments provide an important opportunity to improve automotive cybersecurity, through transparent compliance with global regulations (such as UNECE 155/156) and improved flexibility for common security requirements that meet market demands. GlobalPlatform, an international member-driven standards organization, which has more than 25 years of experience in enabling secure-by-design digital services and devices globally, with Secure Elements (SEs) and Trusted Execution Environments (TEEs). This presentation will discuss how GlobalPlatform has been working together with the Society of Automotive Engineers (SAE) on supporting the specifications and detailed implementation requirements in compliance with the requirements for SAE's J3101 (Hardware Protected Security Environments). This market alignment has the potential to provide the automotive industry, JSAE, and Japanese members a foundation for further alignment on common security standards. This alignment supports vendors and OEMs in focusing their engineering efforts on core differentiators (instead of common security requirements), streamlines

requirements for RFPs, and transparently demonstrates alignment with security requirements associated to SAE.

20259094 **Uncertainty when Testing Electric Vehicle Drive Trains**
- Propagation of Measurement Uncertainty to Power (Loss), Efficiency and Energy Consumption -

Alexander Stock [1], Klaus Lang [1], Marjorie Takai [2]
([1]Hottinger Brüel & Kjær GmbH, [2]Spectris Co., Ltd.)

Abstract:
This paper discusses the relevance of precise measurements for the evaluation of the development and optimization process of the powertrain, or individual powertrain components, of electric vehicles in the context of measurement uncertainty (MU). It presents an innovative fiber-optic measurement technology that combines a sufficiently high bandwidth with a comparatively low MU. In addition to an introductory overview of the measurement technology used, the estimation of MU is examined in detail. In this context, the propagation of the MU of electrical measurands to relevant optimization parameters, such as active power, energy and efficiency, is analyzed. For this purpose, a time-discrete MU propagation is used, which considers the digital calculation algorithms implemented on modern power analyzers. In contrast to numerous established methods for estimating the MU of electrical power, energy and efficiency, this approach can also be used for non-sinusoidal voltages and currents, as they occur in converter-fed drives.

20259095 **Securing the Future of Electric Vehicles: A Novel Approach Using MILS and Zero Trust Architecture**

Jun Anzai [1], Yoshiharu Imamoto [1]
([1]Panasonic Automotive Systems Co., Ltd.)

Abstract:
The automotive industry is rapidly evolving due to technological advancements, particularly in vehicle architecture and CASE (Connected, Autonomous, Shared, Electric) technologies. Traditional Gateway (GW) architectures are transitioning to domain and zone architectures, facilitating the rise of Software-Defined Vehicles (SDVs). However, this integration increases security risks. This paper explores the application of Multiple Independent Levels of Security (MILS) and Zero Trust Architecture (ZTA) to vehicle systems. We propose a novel security approach to enhance vehicle system security and support sustainable evolution. This study aims to provide new perspectives for securing advanced automotive systems.

20259096 **Full EV Vehicle Model for Digital Authentication Through Virtual Testing**
- Comprehensive CO2 Reduction and New Manufacturing Methods -

Kimitoshi Tsuji [1], Toshiji Kato [2], Tsunehiro Saito [3], Masahiro Okamura [4]
([1]Digital Twins Inc., [2]Doshisha University, [3]AGC Inc. [4]JSOL, INC.)

Abstract:
Until now, physical testing and certification have been accepted because of the reassurance that it is performed on actual products. However, the test conditions that must be satisfied by physical testing and certification have become increasingly diverse, and it is becoming more difficult to meet these conditions with physical testing. It is thought that certification by simulation with guaranteed equivalent performance can guarantee more realistic values. The authors have started a demonstration test to verify the equivalence of the EV vehicle model developed by the authors to actual measurements and the certification mechanism using the model.

20259097 **Quantifying Traffic Congestion Caused by Vehicle Platooning**
- A Statistical Approach and Empirical Validation –

Kizuku Yamada [1], Takashi Nishikiori [1], Masanori Shimada [1], Tomomi Yamada [1], Toshiya Hashimoto [1]
([1]TOYOTA MOTOR CORPORATION)

Abstract:
As the adoption of electric vehicles progresses towards the realization of a carbon-neutral society, platooning on highways, which involves following a lead vehicle, is recognized as a method that

contributes to the reduction of greenhouse gas (GHG) emissions by decreasing air resistance. On the other hand, since two or more vehicles travel in a line, there is a concern that this will occupy long sections of the roadway and create local traffic congestion around them. This paper attempts to quantify the "congestion caused by vehicles overtaking a platoon," proposing a prediction method based on statistical theory formulas and validating it through actual measurements. As a result, the average error was kept under 20%, confirming that predictions based on statistical theory formulas are feasible. Additionally, it was found that congestion due to low-speed platooning is more pronounced, highlighting the importance of selecting the lead vehicle. Overall, to achieve GHG-optimized traffic flow, it is necessary to establish appropriate platooning guidelines.

B32-EP **System Desing for BEV and HEV**

Room B (14:55-16:35)

Chairs: Takeshi Kato (Honda R&D Co., Ltd.)
Satoru Hirano (Hino Motors, Ltd.)

20259098 **Pathways to the Next Stage of E-Mobility**
- Affordable, Safe and Sustainable -
Gerhard Meister [1], Adam Dendrinos [1], Tom Horvat [1], Benjamin Langer [2], Martin Rothbart
([1]AVL List GmbH, [2]AVL Software and Functions GmbH, [3]AVL List GmbH)

Abstract:
Electromobility is considered a key contributor in the transformation towards sustainable mobility. Despite the clearly positive contribution battery electric vehicles provide to reducing CO_2 emissions [1] from road traffic, the take rate by consumers in the main markets is not in line with ambitious ramp-up targets for battery electric vehicle (BEV) deployment. This paper derives a prioritized set of challenges that need to be addressed to enable widespread e-mobility adoption. For these challenges in the order of their priority strategies are discussed and concrete examples of technical solutions given on vehicle side to enable a broader consumer adoption of electric vehicles.

20259099 **Sustainable EDU Solutions**
- AVL's Pathway Forward to Support e-Mobility with Power Dense, Efficient, Sustainable and Cost Attractive Electric Drive Unit (EDU) Solutions -
Wilhelm Vallant [1], Mathias Deiml [2], Gernot Fuckar [1], Martin Rothbart [1], Kristian Fleck [1]
([1]AVL List GmbH, [2]AVL Software and Functions GmbH)

Abstract:
The e-mobility market is projected to continue its growth, leading to increasing production volumes annually. Consequently, the demand for materials such as copper, magnets, semiconductors, and metal sheets is substantial, potentially putting the transition to green mobility at risk. It is the automotive industry's responsibility to navigate this path carefully, making informed decisions to manage the demand for critical raw materials. This paper explores various technological approaches to enhance the sustainability of electric powertrains. A product lifecycle CO_2e evaluation is employed to assess the impact of individual technologies. Solutions such as the implementation of high-speed e-motors with high power density and/or state-of-the-art energy-efficient e-axle systems are described and analyzed. The CO_2e footprint over the application lifetime serves as the primary criterion for comparing different technical solutions. Additionally, measures to further improve the CO_2e footprint through increased integration and the use of recycled materials are discussed.

20259100 **Investigation of Safety Design Methods for Low to Medium Speed Mobility Systems in Logistics**
Shota Hori [1], Takuma Hirasawa [1], Koji Hagiwara [1], Shigehiro Sugihira [1], Yasutaka Fujiwara [1], Masakazu Owatari [1]
([1]TOYOTA MOTOR CORPORATION.)

Abstract:
Currently in Japan, the aging workforce in a logistics sector and restrictions on working hours have led to the severe labor shortage problem. As one solution to this issue, the research and development of mobility equipped with autonomous driving functions for last-mile delivery are being actively explored.

These mobilities are designed for a wide range of speeds, from walking speed (3 km/h) to bicycle speed (20 km/h), and there has been extensive technical discussion on this topic. However, there has been relatively less discussion regarding safety performance. In this paper, our approach is based on the safety design and quality evaluation concepts that have been previously considered for automobiles, developed the safety quality considerations for low to mid-speed (up to 20 km/h) mobility vehicles, and conduct evaluation and verification through simulations targeting operations within restricted areas, including roadways.

20259101 **THS Engine Torque Detection System Using Motor/Generator Resolver - xEV Technology That Utilizes the Potential of Engine for the Multi-Pathway Approach -**

Kohei Yasumura [1], Nobuhiro Kotake [1], Takeshi Kitahata [1], Takashi Suzuki [1], Koichiro Muta [1]
([1]Toyota Motor Corporation)

Abstract:
This paper presents the onboard engine torque detection system in the THS. Each type of torque can be calculated based on a physical model using the motor-generator resolvers and engine crank angle sensor signals. High-precision torque estimation is possible by synchronously calculating each sensor signal utilizing the engine crank angle signal as a trigger. Countermeasures against misalignment due to mass production, such as eccentricity of the timing rotor and resolver, are also implemented. Experimental results show that engine torque can be estimated with high precision. This method is expected to improve the NV performance, efficiency, and emissions of electric vehicles such as HEVs and PHEVs, further contributing to carbon neutrality.

20259102 **The Electrified Control Technology for Toyota's L4A0 and L580 - Electrification Control Technologies for Motor-Generator -**

Mu Hu [1], Masayuki Baba [1], Yoshiyuki Teratani [2], Yoshiaki Tsuruta [2], Nobufusa Kobayashi [2]
([1]Toyota Motor North America, [2]Toyota Motor Corporation)

Abstract:
Toyota has developed the L4A0 and L580 hybrid units to electrify its full-size and midsize pickup trucks. These electrified powertrains aim to achieve optimal environmental performance in line with Toyota's goal of Carbon Neutrality, while exceeding customer expectations for drivability across diverse conditions, including on-road, off-road, and towing situations. In these hybrid units, a motor-generator and a K0 disconnect clutch are integrated into a single module, positioned between the conventional engine and automatic transmission. Hybrid capabilities are realized through various control functions for the motor-generator and disconnect clutch. Electric motor torque is utilized to enhance dynamic acceleration by reducing turbo lag and increasing total system torque. A smooth transition between EV driving and HEV driving is achieved through sophisticated control of the K0 disconnect clutch. Engine power suppression control has been developed to improve emissions, and anti-vibration control has been implemented to reduce powertrain surge.

C32-FC **Fuel Cell Technology 2**

Room C (14:55-16:35)

Chairs: Kenichiro Ueda (Honda R&D Co., Ltd.)
Yoshinori Yamamoto (MITSUBISHI MOTORS CORPORATION)

20259103 **Capillary Pressure-Water Saturation Relations for Gas Diffusion Layers Affecting Water Transport and PEFC Polarization Behaviors**

Shohji Tsushima [1], Shota Tateyama [1], Takahiro Suzuki [1], Naoki Hirayama [2], Mitsunori Nasu [2], Masahiro Watanabe [3], Akihiro Iiyama [3], Makoto Uchida [3]
([1]Osaka University, [2]Enomoto Co., Ltd., [3]University of Yamanashi)

Abstract:
Numerical simulations using a two-phase flow, non-isothermal model with the capillary pressure-water saturation relations considered have been carried out to examine the effects of liquid water transport properties of GDL materials on cell performance. A designed GDL having a different capillary pressure-water saturation relation from the conventional GDL showed better cell performance at high

current density, indicating improved mass transport. Numerical simulation indicates the direction to develop an engineered design of the porous structure for the GDL substrate to reduce the concentration overpotential.

20259104 **A Novel Approach to Polymer Electrolyte Fuel Cell Electrode Slurries**

Takahiro Suzuki [1], Ryo Kirigaya [1], Hajime Ooya [1], Kayoko Tamoto [2], Makoto Uchida [2], Shohji Tsushima [1]
([1]Osaka University, [2]University of Yamanashi)

Abstract:
This study presents a novel approach to evaluating the fabrication process of the catalyst layer. In a polymer electrolyte fuel cell, the catalyst layer represents a reaction field where reactions and mass transport are coupled. The distribution of materials within the catalyst layer and the porous structure of the catalyst layer have an important effect on cell performance. The catalyst layer is fabricated from an electrode slurry, which is prepared by dispersing platinum-supported carbon and ionomers. The structure of the catalyst layer is formed by applying and drying the electrode slurry, but this process is complexly coupled with material composition and process conditions. Furthermore, it is necessary to capture the state of the non-steady-state process of the applied film, which has made it challenging to evaluate in the past. In this study, we investigated the electrode slurry drying process by combining optical methods using a confocal microscope and micro-AC impedance measurement for understanding of the structure formation mechanisms of the catalyst layer.

20259105 **Energy Management System for Hydrogen Vehicles Considering State of Health of Fuel Cells and Lithium Batteries**
- State of Health Integration Using LSTM and ANN-based ECMS for Improved Hydrogen Consumption-

Chi-Chang Huang [1], Zheng-Wei Fan [1], Yi-Hsuan Hung [1], Tsu-Yang Tsai [2]
([1]National Taiwan Normal University, [2]Industrial Technology Research Institute)

Abstract:
This paper proposed a new method to define and to evaluate the State of Health (SOH) of fuel cells (FC) in hydrogen- powered vehicles. The proposed SOH estimation uses Long Short-Term Memory (LSTM) networks to monitor FC voltage degradation, while lithium battery SOH is based on electric capacity loss. To optimize energy management, an advanced Energy Management System (EMS) is developed by combining an Artificial Neural Network (ANN) with the Equivalent Consumption Minimization Strategy (ECMS). This EMS considers both SOHs for FCs and batteries in order to extending battery life and improving vehicle mileage. A rule-based control strategy is also provided for comparison. Simulations are under two scenarios: (1) at FC SOH is high (100%) and battery SOH is low (80%), ECMS and ANN-ECMS reduce hydrogen consumption by about 37% and 32%, respectively, which are compared to the baseline cases; (2) at FC SOH is low (80%) and battery SOH remains high (100%), these methods achieve reductions of approximately 39% and 32%, respectively.

20259106 **The StasHH Size, Interface, and Testing Protocol Standards for Fuel Cell Modules in Heavy-Duty Applications**
- Definition of an Industry-Driven Fuel Cell Module Standard -

K.J. Mrozewski [1], A. Balaji [1], C. Bekdemir [1], R. Bouwman [2], H. Lundkvist [3]
([1]TNO Powertrains, [2]VDL Enabling Transport Solutions, [3]SINTEF Digital)

Abstract:
This paper describes an industry-driven standard for heavy-duty hydrogen fuel cell modules, defining their form factors, physical and digital interfaces as well as testing protocols. The standardized modules aim to serve diverse applications, including ships, trains, stationary generators, and heavy-duty vehicles. The objective of the standardized tests protocols is to provide an casily implementable framework for consistent validation and benchmarking of fuel cell module performance metrics, aligning with industry requirements. Currently, no unified standard exists for fuel cell module interchangeability and testing. Such a standard could consolidate markets, expedite development and deployment of hydrogen fuel cells in heavy-duty applications, foster competition among manufacturers, and lower the total cost of ownership. The StasHH project is addressing the lack of standardization of fuel cell modules by developing prototypes from seven major fuel cell manufacturers, with testing of eight fuel cell modules.

The developed standards have been proposed to the IEC TC105 standardization committee for review, vote, and potential further work and adoption.

C33-FC **Fuel Cell Technology 3**

Room C (16:50-17:50)

Chairs: Takahiro Suzuki (Osaka University)
Shohji Tsushima (Osaka University)

20259107 **Advanced Ion-Pair High-Temperature Polymer Electrolyte Membrane Fuel Cells**

Liang Wang [1], Keiichi Okubo [2], Atsushi Hiraide [2], Satoshi Nagao [2], Hiroki Okabe [2], Masaki Ando [2]
([1]Toyota Research Institute of North America, [2]Toyota Motor Corporation)

Abstract:
High-temperature proton exchange membrane fuel cells (HT-PEMFCs) for heavy-duty applications have gained significant attention due to their advantage in thermal management. Unlike the traditional phosphoric acid-doped polybenzimidazole (PA/PBI) based membrane, which is only stable when operating between 140°C to 160°C at low current density, an ion-pair membrane type was developed. The ion-pair membrane is based on quaternary ammonium-biphosphate ion-pair coordination. The ion-pair MEA has a much wider operating temperature (80°C-200°C) and is stable for the dynamic operation of fuel cells. This advancement enhances HT-PEMFCs' potential for heavy-duty applications, providing improved heat rejection, simpler water management, and higher tolerance to fuel impurities. Our work focuses on improving the performance of the ion-pair membrane electrode assemblies (MEAs) by enhancing oxygen transfer and mitigating phosphoric acid (PA) poisoning of the oxygen reduction reaction (ORR). We explored carbon paper as a gas diffusion layer (GDL) to replace carbon cloth, aiming to enhance mass transfer in the MEA. Additionally, we used ionic liquid (IL) to shield the Pt catalyst from PA poisoning, thereby boosting catalytic activity. Based on these insights into advancing MEA performance, we will share our perspectives on further enhancing MEAs in ion-pair HT-PEMFCs for heavy-duty applications.

20259108 **Development of an Integrated Fuel Cell System Simulator "FC-DynaMo"**
- Toward Acceleration of Advanced Research and Product Development -

Shigeki Hasegawa [1], Sanghong Kim [2], Miho Kageyama [1], Motoaki Kawase [1]
([1]Kyoto University, [2]Tokyo University of Agriculture and Technology)

Abstract:
A 1-dimentional (1D) model to simulate the dynamic behavior of an integrated fuel cell (FC) system was developed. The model consists of the physical models of the FC stack and the hydrogen (H_2), air, and coolant systems. To ensure numerical simulation of the entire FC system in life-long system operation (> 10 years) in acceptable calculation time, a proper model resolution is selected. The subsystem models are integrated with the FC stack model and controllers to build a closed-loop simulator of an integrated FC system. The dynamic system behavior of the FC system and the overall system performance, such as fuel economy and thermal balance, are simulated. It was demonstrated that the complicated relationships between the specifications of the fuel cell materials, system components, and the overall system performance could be quantified. In recent, the developed simulator has been extended with the models to estimate the rate of the FC catalyst degradation. It is expected that considerable efforts on development of various FC system products by the topological investigations with the costly prototypes can be replaced with the numerical simulation.

20259109 **Evaluation of Standardized Testing Protocols for Fuel Cell Modules in Heavy-Duty Applications**
- Measurement Results from 7 Standard Sized Fuel Cell Prototypes -

A. Balaji [1], K.J. Mrozewski [1], C. Bekdemir [1], Y. Wang [2], E. Havret [3]
([1]TNO Powertrains, [2]FEV, Motor Hybrid and Fuel Cell Powertrains, [3]CEA, Energy Division)

Abstract:
Standardization is key to accelerate fuel cell deployment into a wide array of heavy-duty markets. Therefore, a collective of heavy-duty Original Equipment Manufacturers, fuel cell manufacturers, and

research institutes have proposed standards of fuel cell module size, interface, and testing protocols. The objective of this study is to evaluate the 6 tests from the standardized testing protocols by applying them to 7 PEM fuel cell modules of different fuel cell suppliers. The tested modules have a nominal power in the range of 42.5 to 125kW. As a result, key performance indicators such as efficiency and dynamic behavior of these state-of-the-art prototypes will be presented. Experiences of applying these protocols and processing the measurement data will be shared. Furthermore, recommendations will be given for experimental works that intend to apply these fuel cell module protocols in the future.

Authors' Index

L

M

Y

Z

MEMO

DENSO
Crafting the Core

Dynamic Wireless Power Transfer
走行中非接触給電

ELEXCORE

デンソーの電動化製品ブランド エレックスコア

高性能・高効率・軽量化を具現化した
電動化製品ブランド「エレックスコア」は
あらゆるモビリティの電動化の核となり
パーソナルで快適な移動の実現と地球環境の
保全に貢献することを目指しています。

MG

Inverter

BMU

詳細はこちら：
デンソーのニュースサイト『DRIVEN BASE』

NEW CROSSTREK

SUBARU

SUBARU STRONG HYBRID 登場

優れた燃費性能と力強い加速。新しい走りの愉しさを、クロストレックから。

アイサイトX

Premium S:HEV EXにはロングドライブを
さらに安心・快適にする「アイサイトX」を標準装備。

PHOTO：Premium S:HEV EX　マグネタイトグレー・メタリック　アクセサリーコンセント（AC100V/1500W）、サンルーフ、ルーフレールはメーカー装着オプション　写真は撮影用に点灯しています。写真はすべてイメージです。
●写真は印刷インクの性能上、実際の色とは異なって見えることがあります。●この仕様はお断りなく変更する場合があります。
●詳細は店頭またはWEBでご確認ください。

クロストレックを
もっと知る

［SUBARU お客様センター］ SUBARUコール 0120-052215

安心と愉しさを。SUBARU


Honda 0

TOYOTA Technical Review

［トヨタ·テクニカル·レビュー］

**トヨタは、ステークホルダーへの技術紹介を通じた仲間づくりを目的に
トヨタ·テクニカル·レビューを発行しています。**

最新号 Vol.70-2

- **特集**
  続・トヨタが取り組む
  サーキュラーエコノミーとは
- **モビリティ解説**
  病院内で活躍する搬送ロボット
  “Potaro”

＼ バックナンバーも公開中 ／

最新号・バックナンバーの
閲覧はこちらから

English versions
are here

トヨタ·テクニカル·レビュー
へのご意見はこちら

TOYOTA

Timetable

DAY 1 May 19 MONDAY

Room	Plenary Room		
9:20	**Opening Ceremony**		
9:30	**PS 1** Toyota‘s Approach for Vehicles and Cities Energy and Power Management Takashi UEHARA (**TOYOTA MOTOR CORPORATION**)		
10:10	**PS 2** Creating New Values for Mobility Kojiro OKABE (Sony Honda Mobility Inc.)		
10:50	**PS 3** Direct-Drive In-Wheel Motor: Latest Innovations from Astemo Akeshi TAKAHASHI (Astemo, Ltd.)		
11:30	By own lunch 11:30-12:40		
Room	Room A	Room B	Room C
12:40	**A11-WPT** Static Wireless Power Transfer 1	**B11-MOT** High Speed Machines for Transportation Applications	**C11-EP** eAxle and Next Generation Propulsion System
14:20	Break 14:20-14:35 (15min)		
14:35	**A12-WPT** Static Wireless Power Transfer 2 & Electric Drive Technology	**B12-MOT** Performance Improvement of Electric Machines	**C12-PE** Automotive Power Electronics Technology 1
16:15	Break 16:15-16:30 (15min)		
16:30	**A13-WPT** Electromagnetic Compatibility for Wireless Power Transfer	**B13-EP** Technology for In-wheel Motor	**C13-PE** Automotive Power Electronics Technology 2
17:50			

DAY 2 May 20 TUESDAY

Room	Plenary Room		
9:30	**PS 4** Nissan's Strategy for Future Mobility Through Electrification Eiichi AKASHI (Nissan Motor Co., Ltd.)		
10:10	**PS 5** Sodium-Ion Batteries: Materials Science towards Future Energy Storage Shinichi KOMABA (Tokyo University of Science)		
10:50	**PS 6** The Global Need for Wireless ERS Andreas WENDT (Electreon Germany GmbH)		
11:30	By own lunch 11:30-12:40		
12:40	**Keynote Speech 1** Overcoming the Barrier of Using Second-life EV Batteries for Storage Applications Chris MI (San Diego State University)		
13:10	Short Break 13:10-13:20 (10min)		
Room	Room A	Room B	Room C
13:20	**A21-WPT** Dynamic Wireless Power Transfer 1	**B21-EP** Vehicle Motion and Stability Control	**C21-BAT** Application of Energy Storage System 1
14:40	Break 14:40-14:55 (15min)		
14:55	**A22-WPT** Dynamic Wireless Power Transfer 2 & Electric Drive Technology	**B22-MOT** Motor Drive Technologies	**C22-BAT** Application of Energy Storage System 2
16:35	Break 16:35-16:50 (15min)		
16:50	**A23-WPT** Other Applications for Wireless Power Transfer	**B23-MOT** Motor Technologies	
17:50			
18:10	Reception Party 18:10-20:30 *pre-reserved only		

DAY 3 May 21 WEDNESDAY

Room	Plenary Room		
9:30	**PS 7** Honda’s Pursuit of Carbon Neutrality and Electrification Technology Keiji OTSU (Honda R&D Co., Ltd.)		
10:10	**PS 8** A Review of the Current Trends in Japan's Policies and Technological Developments Toward the Realization of a Hydrogen Society Hidenori SAKA (New Energy and Industrial Technology Development Organization (NEDO))		
10:50	**PS 9** Cutting Edge Power Electronics Technology Applied to the Cybertruck (Tesla) and Chinese xEVs, and Japan's xEV Market Strategy for 2030 Masayoshi YAMAMOTO (Nagoya University)		
11:30	By own lunch 11:30-12:40		
12:40	**Keynote Speech 2** What an ICE Can Do and What an ICE Should Do Hiroshi KAWANABE (Kyoto Univeristy)		
13:10	Short Break 13:10-13:20 (10min)		
Room	Room A	Room B	Room C
13:20	**A31** Grid & Charging Technology	**B31-BAT** Energy Storage System Technologies	**C31-FC** Fuel Cell Technology 1
14:40	Break 14:40-14:55 (15min)		
14:55	**A32** Advanced Simulation & Measurement Technology	**B32-EP** System Design for BEV and HEV	**C32-FC** Fuel Cell Technology 2
16:35	Break 16:35-16:50 (15min)		
16:50			**C33-FC** Fuel Cell Technology 3
17:50	**Award, Closing Ceremony**		
18:10			