CONFERENCE PROGRAM

MEPE 2026

2026 5th International Conference on Mechanical Engineering and Power Engineering

Workshop: ICPSG 2026

2026 9th International Conference on Power and Smart Grid

November 14-16, 2026 | Seoul, South Korea (GMT+9)

Co-sponsored by

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November 15, 2026 (Sat.)

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Note



WELCOME MESSAGE

We are pleased to welcome you to attend the 2026 5th International Conference on Mechanical Engineering and Power Engineering (MEPE 2026) with workshop: 2026 9th International Conference on Power and Smart Grid (ICPSG 2026) held in Seoul, South Korea, from November 14-16, 2026 co-sponsored by Kookmin University, South Korea and IEEE.

This event will provide a unique opportunity for international scholars, researchers and practitioners working in a wide variety of scientific areas with a common interest in mechanical engineering and power engineering.

This year's conferences will be composed of 2 keynote speeches successively delivered by Prof. Makoto Iwasaki (Nagoya Institute of Technology, Japan) and Prof. Prof. Dimitrios Karamanis (University of Patras, Greece), 2 invited speech given by Prof. Jun-Ho Huh (National Korea Maritime and Ocean University, South Korea) and Assoc. Prof. Mohamad Ridzwan Ishak (Universiti Putra Malaysia, Malaysia) followed by 4 oral sessions and 1 online session.

We would like to deeply express our heartfelt appreciation to all our delegates, keynote speakers, invited speaker, session chairs as well as all the committee members involved in the technical evaluation of conference papers and in the conference organization for your time, effort, and great contributions. Apart from that, we'd like to extend our thanks to all the authors and external reviewers for your contribution. It is your high competence, enthusiasm, valuable time and expertise that have enabled us to prepare the final program with high quality and make the conference a great success.

We wish to thank all attendees for participating in the conferences and hope you have a fruitful and memorable experience at the conference.

Finally, we wish you a very successful conference! Hope you will enjoy your stay in Seoul!

With Warmest Regards,

Conference Organizing Committees

MEPE 2026 & ICPSG 2026

GENERAL INFORMATION

Onsite Registration

Registration desk→ Inform the staff of your paper ID→ Sign-in→ Claim your conference kit.

Devices Provided by the Organizer

Laptops (with MS-Office & Adobe Reader) / Projectors & Screen / Laser Sticks

Materials Provided by the Presenter

Oral Session: Slides (pptx or pdf version; Format 16:9 is preferred); USB Drive.

Official language: English. Slides Template

Duration of Each Presentation

Keynote Speech: 40min, including 5 min Q&A. Invited Speech: 30min, including 5 min Q&A.

Oral & Online Session: 15min, including 3min Q&A.

Notice

- Please wear your delegate badge (name tag) for all the conference activities. Lending your participant card to others is not allowed.
- Please take good care of your valuables at any time during the conference. The conference organizer does not assume any responsibility for the loss of personal belongings of the participants during conference day.
- Program Time: **GMT+9** / **Time in Seoul**. Please be aware of time difference between this and your region/country.

Online Presentation via Zoom Meeting Platform

Zoom ID: 817 1417 2996 (Zoom Download)

https://us02web.zoom.us/j/81714172996

Zoom Background / Conference Banner

Note:

We recommend that you install the Zoom platform on your computer before the conference starts. New users can participate in the Zoom meeting without registration.

Participants who are going to do an online presentation are required to join the rehearsal in Zoom on Saturday, November 14, 2026. Duration: 3min apiece. Feel free to leave after you finish the test.

Please set your display name before joining the online meeting. For instance,

Author/Presenter: Paper ID-Name < ME001-Full Name >

Session Chair: <Session Chair-Full Name>

Delegate: <Delegate- Full Name>

GENERAL INFORMATION

Conference Venue

HOTEL SKYPARK

Hotel Skypark Kingstown Dongdaemun

Address: 20, Jangchungdan-ro 13-gil, Jung-gu, Seoul, South Korea

Tel: 010-7203-3241 Reservation Link



Meetings Rooms

November 14: Meeting Room I / November 15: Kings Hall II+III **<14th Floor>**

Dinning

November 15: Garden Serano Restaurant **<14th Floor>**



VENUE & TRANSPORTATION

1. Subway

Subway Station	Exit	Walking Distance
Dongdaemun Station (Line 4)	**Exit 8** → Hyundai City Outlet, Gate 3	Approx. 5 min
Dongdaemun History & Culture Park Station (Line 2)	**Exit 14** → Hyundai City Outlet, Gate 4	Approx. 6 min

2. By Airport Limousine Bus

-Incheon International Airport

Terminal	Boarding Point	Bus No.	Get Off At	Walking Distance
T1	1F, Stop 5	6001	Euljiro Co-op Residence / Skypark Kingstown	Approx. 7 min
T2	B1, Stop 29			
T1	1F, Stop 3	6702	Dongdaemun Design Plaza (DDP)	Approx. 5 min
T2	B1, Stop 18			

-Gimpo International Airport

- Boarding Points: Domestic Terminal, Stop 4 / International Terminal, Stop 6
- Bus No.: 6021
- Get Off At: Dongdaemun History & Culture Park
- Walking Distance: Approx. 8 min

3. By Airport Express Train

- Take the A'REX Express Train from Incheon International Airport to Seoul Station.
- Take the complimentary hotel shuttle bus from Seoul Station to HOTEL SKYPARK.

Hotel Shuttle Bus Schedule (Seoul Station → HOTEL SKYPARK)

- First Departure: 9:25 AM
- Last Departure: 6:30 PM

Ticket Information: A'REX Express Train tickets can be purchased with assistance from the hotel front desk.
Hotel Shuttle Bus Details:
https://www.skyparkhotel.com/html/offers/board_bus.asp

4. Parking Information

One complimentary parking space per room is available for registered hotel guests only.
Parking is provided from the actual check-in time until check-out (maximum until 12:00 noon on the check-out date).
Parking regulations follow those of Hyundai City Outlet Dongdaemun.
Additional parking fees resulting from exceeding the permitted parking period must be paid directly at the parking payment kiosk.
For further information, please contact the hotel front desk.

CONFERENCE COMMITTEE

Conference Advisory Committees

Makoto Iwasaki (Fellow, IEEE), Nagoya Institute of Technology, Japan

Hongfa (Henry) Hu, University of Windsor, Canada

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Conference Co-Chair

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Azura Che Soh, Universiti Putra Malaysia, Malaysia

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Giovene Perez Campomanes, Universidad Continental, Peru

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Masita Mohammad, Universiti Kebangsaan Malaysia, Malaysia

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Jeff Kilby, Auckland University of Technology (AUT), New Zealand

Ma Ming, Electirc Power Research Institute of Guangdong Power Grid Co.,Ltd, China

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Ricardo Nuno Madeira Soares Branco, University of Coimbra,Coimbra, Portugal

Malinee Sriariyanun, Malinee Sriariyanun King Mongkut's University of Technology North Bangkok, Thailand

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Pichet NINDUANGDEE, Phetchaburi Rajabhat University, Thailand

Md. Akhtaruzzaman, Universiti Kebangsaan Malaysia, Malaysia

Chokchai Mueanmas, Thaksin University, Phatthalung Campus, Thailand

AGENDA OVERVIEW

November 14, 2026 (Sat. GMT+9)

14:00-17:00	On-site Registration/Sign-in	14F Meeting Room I <Hotel Skypark Kingstown Dongdaemun>
14:00-15:30	Zoom Test for Online Presenter	Zoom ID: 817 1417 2996 Link: https://us02web.zoom.us/j/81714172996

Timetable for Zoom Test

14:00-15:00	ME009 ME032 ME043 ME022 ME049 ME054 ME044 ME1001 ME055
15:00-15:30	※Participants who are unavailable during the above allocated time can join the rehearsal at 15:00-15:30.

AGENDA OVERVIEW

November 15, 2026 (Sun. GMT+9) Plenary Meeting

Kings Hall II+III 14F <Hotel Skypark Kingstown Dongdaemun>

08:30-09:00	On-site Registration/Sign-in	
09:00-09:10	Chairman Welcome Address	<Conference General Chair> Prof. Woongchul Choi, Kookmin University, South Korea
09:10-09:50	Keynote Speech I	**Prof. Makoto Iwasaki, IEEE Fellow** Nagoya Institute of Technology, Japan *Speech Title: Motion Control for Industrial Positioning Devices with Strain Wave Gearing: Basics, Applications, and Beyond*
09:50-10:30	Keynote Speech II	**Prof. Dimitrios Karamanis** University of Patras, Greece *Speech Title: Powering the Future with Urban BIPV Systems*
10:30-10:50	Group Photo & Coffee Break	
10:50-11:20	Invited Speech I	**Prof. Jun-Ho Huh** National Korea Maritime and Ocean University, South Korea *Speech Title: From Smart Grid to Super Grid and Space Edge Computing: Rethinking the Future of Power Infrastructure*
11:20-11:50	Invited Speech II	**Assoc. Prof. Mohamad Ridzwan Ishak** Universiti Putra Malaysia, Malaysia *Speech Title: Development of Composite Structural Components: From Composite Cross-Arms for Power Transmission Towers to Broader Engineering Applications*
11:50-13:30	Buffet Lunch <Garden Serano Restaurant 14F>	

AGENDA OVERVIEW

November 15, 2026 (Sun. GMT+9) Parallel Oral Session

TIME	ACTIVITY	VENUE
13:30-15:30	**Oral Session 1: Electrochemical Multiphysics Modeling and Conjugate Heat Transfer Optimization Techniques** *Chairman: Assoc. Prof. Xinyan Pei, Tsinghua University, China* ME005 ME011 ME013 ME015 ME018 ME019 ME052 ME040	Kings Hall II 14F
13:30-15:15	**Oral Session 2: Vibration Suppression and Nonlinear Dynamics Modeling and Control Methods** *Chairman: Assoc. Prof. Asnor Juraiza Ishak, Universiti Putra Malaysia, Malaysia* ME017 ME023-A ME024-A ME027-A ME037 ME039 ME053	Kings Hall III 14F
15:15-16:00	Coffee Break	
16:00-17:30	**Oral Session 3: Battery Health Management and Coordinated Scheduling Techniques for Multi-Type Energy Storage** *Chairman: Prof. Tomoaki Hashimoto, Osaka Institute of Technology, Japan* ME056-A ME057-A ME602 ME603 ME604 ME605	Kings Hall II 14F
16:00-17:30	**Oral Session 4: Data-Driven Predictive Scheduling Methods for Manufacturing Processes and Energy Systems** *Chairman: Assoc. Prof. Azura Che Soh, Universiti Putra Malaysia, Malaysia* ME026-A ME031 ME036 ME042 ME608 ME609	Kings Hall III 14F
13:30-17:30	**Poster Display** ME035	Kings Hall II
17:45-19:30	Buffet Dinner <Garden Serano Restaurant 14F>	

AGENDA OVERVIEW

November 15, 2026 (Sun. GMT+9) Online Session

TIME	ACTIVITY
15:00-17:15 **(Zoom: 817 1417 2996)**	**Online Session 1: Multiphysics Modeling and Intelligent Diagnostic Techniques for Renewable Energy and Mechanical Systems** *Chairman: Assoc. Prof. Raul Duarte Salgueiral Gomes Campilho, ISEP – School of Engineering, Porto, Portugal* ME009 ME032 ME043 ME022 ME049 ME054 ME044 ME1001 ME055

Note

* Online Meeting conference room will be open 15 mins before scheduled time.

* Online presenters are required to join the Zoom Test on **Saturday, November 14, 2026.** If you are very familiar with Zoom, you can skip this step after confirmation with the conference secretary.

KEYNOTE SPEAKER



Prof. Makoto Iwasaki

Dr. Eng., IEEE Fellow

Nagoya Institute of Technology, Japan

Makoto Iwasaki received his B.S., M.S., and Dr. Eng. degrees in Electrical and Computer Engineering from NIT in 1986, 1988, and 1991, respectively. He served as Vice President of Nagoya Institute of Technology from 2024 to 2025. He is a distinguished leader within the IEEE Industrial Electronics Society (IES). His major service roles include Chair of the IES Fellow Evaluation Committee (2022–2023), Co-Editor-in-Chief of IEEE Transactions on Industrial Electronics (2016–2022), and Vice President for Planning and Development (2018–2021). He was elevated to IEEE Fellow in 2015 for his contributions to fast and precise positioning in motion controller design. He is also a Fellow of the Institute of Electrical Engineers of Japan (IEEJ) and a member of the Science Council of Japan. His scholarly contributions have been recognized with numerous prestigious awards, including Best Paper and Technical Awards from IEE Japan, the Nagamori Award, the Ichimura Prize, and the Commendation for Science and Technology from the Japanese Minister of Education. He was also listed among the World's Top 2% Scientists (2024) by Stanford University and Elsevier. His current research focuses on advanced control theory applied to linear and nonlinear modeling, precision positioning, and intelligent motion control, with strong and sustained collaboration with industry.

Speech Title: Motion Control for Industrial Positioning Devices with Strain Wave Gearing: Basics, Applications, and Beyond

Abstract. This keynote speech presents practical motion control design methodologies for precision positioning systems incorporating strain wave gearing, such as industrial multi-axis robots and high-precision rotational positioning stages. Among various strain wave gear technologies, HarmonicDrive® gears (HDGs) are widely used; however, they inherently exhibit nonlinear characteristics known as Angular Transmission Errors (ATEs) arising from structural errors and elastic deformation within the mechanism. As a result, the theoretically achievable positioning accuracy implied by actuator encoder resolution cannot be fully realized at the gear output. Furthermore, periodic disturbances induced by ATEs often excite mechanical resonances in HDG-based systems, particularly when the frequencies of synchronous ATE components coincide with critical mechanical resonant modes. These phenomena lead to significant degradation in positioning accuracy and vibration performance, presenting fundamental challenges in high-precision motion control. To address these issues, this speech focuses on advanced motion controller design techniques aimed at mitigating ATE-induced disturbances and suppressing resonant vibrations. Assuming that accurate mathematical models of ATEs can be identified, both model-based feedforward compensation and robust feedback control strategies are introduced, along with key considerations regarding sensor placement and system architecture. The proposed

approaches have been implemented in practical precision motion systems, including servo actuators equipped with strain wave gearing. Their effectiveness has been validated through comprehensive numerical simulations and experimental studies conducted in close collaboration with industry partners. The keynote concludes by discussing future perspectives for next-generation intelligent motion control systems utilizing strain wave gearing.

KEYNOTE SPEAKER



Prof. Dimitrios Karamanis

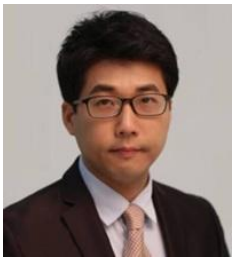
University of Patras, Greece

Professor of Alternative Energy Sources at University of Patras. His research interest started with the development of appropriate countermeasures for the mitigation of the severe environmental consequences of the Chernobyl accident and followed by cross section measurements in the thorium fuel cycle for energy production and waste incineration. Expanded to the study of wind and solar energy systems in the last twenty years, ongoing research is focused on the integration of photovoltaics in buildings and urban infrastructure for electricity generation and its synergy with nature-based solutions towards carbon neutral cities. By participating in national and international research programs as a scientific coordinator and researcher, he has published more than 120 scientific papers in scientific journals, patents and book chapters with >4500 citations and h-index 40 (Scopus). He is member of International Solar Energy Society and serves as Associate Editor of Green Technologies and Sustainability (Elsevier/KeAi) and in the Editorial Boards of Clean Energy & Sustainability; Carbon Footprints; Energy Buildings; Urban Transitions. Prof. Karamanis has been invited expert for European Climate, Infrastructure and Environment Executive Agency; European Institute of Innovation & Technology; EU Clean Energy Transition Partnership; EU Intelligent Cities Challenge; National Research Councils of European & Asian Countries. Prof. Karamanis teaches courses in the subject of renewable energy sources and their applications since 2006 in Departments of the Universities of Ioannina and Patras.

Speech Title: Powering the Future with Urban BIPV Systems

Abstract. The transition to net zero energy buildings and/or cities (NZEBs & NZEC) remains a complex and cost-intensive challenge. Building-integrated photovoltaics (BIPV) offer a high-impact solution, combining passive energy performance with on-site electricity generation. In addition to rooftop PVs, the large available surfaces on the buildings' facades offer unique opportunities to integrate photovoltaics into opaque or transparent areas. Despite the technological maturity of BIPV systems and significant cost reductions, there are still challenges to overcome for the expansion of BIPV applications and their wider adaptation at global level. In recent research, we have validated the strong potential of BIPV to meet energy demands across multiple scales, from individual buildings to neighborhoods and up to carbon-neutral cities by 2030, in agreement with findings from comparable research studies. However, the wider BIPV implementation as an energy transition pathway is constrained by two critical socio-technical barriers: microgrid-based energy sharing and social integration. Addressing these barriers requires targeted research and innovation efforts, which are essential to unlock the full potential of BIPV in urban energy transitions and will be discussed.

INVITED SPEAKER



Prof. Jun-Ho Huh

National Korea Maritime and Ocean University, South Korea

Prof. Jun-Ho Huh has been a Full Professor (Tenured) with the Department of Data Informatics/Data Science, National Korea Maritime and Ocean University, Republic of Korea since April 2025. Also, since September 2020, he has been an Center Chair (Director) of Big Data Center for Total Lifecycle of Shipbuilding and Shipping at National Korea Maritime and Ocean University. Also, since April 2025, he has been Join a Full Professor (Tenured) (Sep. 2022~Mar. 2025: Associate Professor) of Global R&E Program for Interdisciplinary Technologies of Ocean Renewable Energy (BK 21 Four Research Group) of Interdisciplinary Major of Ocean Renewable Energy Engineering, National Korea Maritime and Ocean University, Republic of Korea. Also, since April 2025, he has been a Full Professor (Tenured) (Mar. 2024~Mar. 2025: Associate Professor) of Research Group of Marine Safety and Disasters, Dept. of Convergence Paper on the Ocean Science and Technology, Ocean Science and Technology School (OST School: KMOU & KIOST: Korea Institute of Ocean Science and Technology). Meanwhile, he was an Assistant Professor with the Department of Data Informatics, National Korea Maritime and Ocean University, Republic of Korea, from Sep., 2019 to Sep., 2021. Also, he was an Associate Professor (Tenured) with the Department of Data Informatics, National Korea Maritime and Ocean University from Oct., 2021 to Mar., 2024. Also, he was an Assistant Professor with the Department of Software, Catholic University of Pusan, Republic of Korea, from December 2016 to August 2019. Also, he was a Research Professor at Dankook University at Jukjeon, Yongin, Republic of Korea, from July 2016 to September 2016. He received B.S. in Science Degree from Department of Major of Applied Marine Sciences, And, B.E. in Engineering Degree (Double Major) from Department of Computer Engineering from Jeju National University, Republic of Korea in Aug. 2007. And he received M.A. degree in education from Department of Computer Science Education, Pukyoug National University in Aug. 2012. Also, he received the Ph.D. in Engineering Degree from Department of Computer Engineering, Pukyoug National University, Republic of Korea in Feb. 2016. Prof. Jun-Ho Huh has published more than 125 articles in Clarivate Analytics Index (SCI/SCIE/SSCI indexed) with over 5300 citations and has an h-index of 37. He is Stanford/Elsevier/SCOPUS World Top 2% Scientist (2023, 2024, 2025).

Speech Title: From Smart Grid to Super Grid and Space Edge Computing: Rethinking the Future of Power Infrastructure

Abstract. This Invited Talk presents Full Professor Jun-Ho Huh (Department of Data Science/Interdisciplinary Major of Ocean Renewable Energy Engineering at National Korea Maritime and Ocean University)'s 15-year research journey in Smart Grid technologies (Jun-Ho Huh. Smart Grid Test Bed Using OPNET and Power Line

Communication, IGI Global Book, USA), highlighting key developments, research achievements, and emerging challenges in intelligent power systems. Also, he proposes an overview of the history and evolution of Artificial Intelligence and Big Data, followed by an introduction to landmark research achievements by Google DeepMind, particularly those featured as cover papers in Nature, including Google AlphaGo, AlphaGo Zero, Ithaca, and AlphaFold. The lecture will also explore recent developments, emerging technologies, and future trends in Artificial Intelligence.

Meanwhile, building on this experience, the lecture explores the evolution from Smart Grid to Super Grid (Asia Super Grid, SoftBank Group Corp, Japan), the integration of AI (Smart Factory to Dark Factory in China), Big Data Center for Total Lifecycle of Shipbuilding (Smart Shipyard and Green Shipyard for RE100) and Shipping at National Korea Maritime and Ocean University, Maritime Edge Computing (Submarine Power Cable at Republic of Korea, Jun-Ho Huh et al. Yokohama Zone Undersea Cable Protection) and Space Edge Computing/Space PV System (Lockheed Martin Corporation, USA), and the future of intelligent energy infrastructure. It also discusses how these technological advances may reshape future society, industries, and critical infrastructure.

INVITED SPEAKER



Assoc. Prof. Mohamad Ridzwan Ishak

Universiti Putra Malaysia, Malaysia

Associate Professor Ir. Dr. Mohamad Ridzwan Ishak is a Professional Engineer, academic, researcher, and engineering innovator at Universiti Putra Malaysia (UPM), Malaysia. His research integrates engineering materials, manufacturing, structural engineering, aerospace systems, and sustainable engineering, with interests in metallic materials, composites, creep, durability, failure analysis, and lightweight structures. He undertook research attachment and collaboration at the University of Liverpool and University of Manchester, UK, in advanced composite materials. His major research includes long-term structural performance of pultruded glass fibre-reinforced polymer composite cross-arms for high-voltage transmission towers, in collaboration with Tenaga Nasional Berhad (TNB), Malaysia's national electricity utility. His work addresses creep, durability, structural reliability, and advanced materials for infrastructure. He previously served as Head of the Malaysia Aerospace Research Centre (AMRC) and Head of Structural Design for the Motorised Adjustable Vertical Platform (MAVeP), developed for the Satellite Assembly, Integration and Test Facility of the Malaysia Space Agency (MySA). He has also contributed to microlight aircraft structural design and the development of advanced vacuum and cryogenic pumping systems for aerospace and space-related research, including high-vacuum capabilities for advanced materials and environmental simulation. He has supervised 10 PhD and 4 Master's research graduates and served as examiner or chairman for nearly 60 postgraduate viva examinations. He has contributed through research grants, consultancy, intellectual property, technology transfer, and industry advisory activities. He has published 269 indexed publications, with more than 17,058 citations from 10,250 citing documents and an h-index of 73. He has been recognised among the World's Top 2% Scientists for several years and has delivered keynote and invited lectures internationally and nationally.

Speech Title: Development of Composite Structural Components: From Composite Cross-Arms for Power Transmission Towers to Broader Engineering Applications

Abstract. The increasing demand for reliable, lightweight and durable engineering structures has encouraged the development of composite materials as alternatives to conventional structural materials. Traditionally, Chengal timber has been used for power transmission tower cross-arms since the 1980s. However, the growing difficulty in sourcing suitable timber has created a need for alternative materials that offer reliable mechanical performance, durability and long-term serviceability. To address this challenge, pultruded glass fibre-reinforced polymer (GFRP) composite cross-arms have been developed and introduced for power transmission tower applications. These composite components offer high specific strength, corrosion resistance, electrical insulation and flexibility in structural design. The development and structural assessment of GFRP composites

require a comprehensive understanding of their material characteristics and mechanical behaviour. Particular attention is given to the influence of fibre reinforcement, polymer matrix and pultrusion characteristics on the resulting material properties. Tensile and flexural testing provide essential information on mechanical response under applied loading, while creep investigations examine timedependent deformation under sustained loads. Load-deflection behaviour, dimensional stability and long-term structural reliability are key considerations in evaluating the suitability of composite cross-arms for practical service conditions. Experimental approaches and testing systems are also developed to assess composite performance at both material and structural component levels. Beyond power transmission infrastructure, fibre-reinforced composite materials offer significant potential for other engineering structures, including lightweight structural components for microlight aircraft. Their application involves the consideration of mechanical performance, structural deformation and creep behaviour as alternatives to conventional structural materials. These applications further highlight the importance of integrating material selection, structural design, mechanical characterisation and durability assessment in the development of composite components for different engineering sectors. Overall, the development and application of composite structural components demonstrate the potential of fibre-reinforced polymer materials to address engineering challenges across industrial applications. Further investigations into mechanical performance, creep resistance, environmental durability and structural reliability are essential to support their wider adoption and long-term service performance.

ORAL SESSION 1

Oral Session 1: Electrochemical Multiphysics Modeling and Conjugate Heat Transfer Optimization Techniques

Chairperson: Assoc. Prof. Xinyan Pei, Tsinghua University, China

November 15, 2026 (Sun. GMT+9) **13:30-15:30**	**Kings Hall II-14F**

Time	Paper ID	Speech Title & Presenter
13:30-13:45	**ME005**	Experimental Validation and Conjugate CFD Optimization of a Radial Heat Sink for High-Power Chip-on-Board LEDs under Natural Convection ***Panit Kamma, Kasetsart University, Thailand*** ABSTRACT- Effective thermal management is essential for maintaining the performance, reliability, and lifetime of high-power chip-on-board (COB) light-emitting diode (LED) systems. This study developed and experimentally validated a conjugate heat-transfer computational fluid dynamics (CFD) model to investigate and optimize the thermal performance of a radial heat sink under natural-convection conditions. Experimental measurements were conducted using a radial aluminum heat sink subjected to heat inputs ranging from 5 to 15 W. The measured temperatures were used to validate the numerical model, which demonstrated good agreement with the experimental data, with deviations ranging from 0.46% to 4.77% and an average error of 2.98%. The validated CFD model was subsequently employed to analyze the influence of fin number on the thermal and flow characteristics of the heat sink. Fin configurations ranging from 20 to 50 fins were investigated. The results showed that increasing the fin number initially enhanced heat dissipation by increasing the available heat-transfer surface area. However, excessive fin numbers reduced fin spacing, restricted airflow through the fin channels, and weakened natural-convection cooling. A thermal resistance ratio (TRR) was used to evaluate thermal performance relative to a commercial baseline heat sink with 35 fins. The optimal configuration was identified at approximately 25 fins, providing superior thermal performance while reducing heat-sink mass. The findings provide practical design guidelines for lightweight and thermally efficient heat sinks in high-power COB LED applications.
13:45-14:00	**ME011**	Development and Validation of a Three-Dimensional Two-Phase OpenFOAM Model for Coupled Electrochemical, Species Transport, and Thermal Analysis of Proton Exchange Membrane Fuel Cells ***Chayanid Seanglumlert, Mahidol University, Thailand*** ABSTRACT- Proton exchange membrane fuel cells (PEMFCs) are promising energy-conversion devices due to their high efficiency, low operating temperature, and near-zero emissions. This study develops a three-dimensional two-phase computational fluid dynamics (CFD) model of a PEMFC using OpenFOAM to investigate the coupled electrochemical, species transport, and thermal phenomena within the cell. The model

		employs an Eulerian–Eulerian multiphase approach for gas–liquid transport and incorporates electrochemical reactions through the Butler–Volmer formulation. A grid independence study was conducted using nine mesh configurations, and a mesh containing 236,250 structured hexahedral cells was selected based on accuracy and computational efficiency. The model was validated against experimental polarization data reported by Xu and Liu and Zhang et al., yielding average absolute errors of 17.16% and 10.15%, respectively. The validated model revealed significant oxygen depletion along the cathode channel, with oxygen mass fraction decreasing from approximately 0.16 at the inlet to below 0.06 at the outlet, while hydrogen depletion remained comparatively moderate. Thermal analysis showed that the maximum temperature increased from approximately 340 K at 0.04 A cm^{-2} to nearly 350 K at 0.78 A cm^{-2}. The results demonstrate that oxygen transport limitations strongly influence both polarization behavior and thermal generation, providing valuable insights for PEMFC thermal management and flow-field optimization.
14:00-14:15	**ME013**	Development and Experimental Validation of a Physics-Based PEM Water Electrolyzer Model for Renewable Power System Operation and Power-to-Hydrogen Applications ***Supachai Rumnum, Mahidol University, Thailand*** ABSTRACT- Proton exchange membrane water electrolyzers (PEMWEs) have emerged as a key technology for power-to-hydrogen (P2H) systems because they convert surplus renewable electrical energy into green hydrogen, enabling long-term energy storage and supporting renewable power system operation. However, computationally efficient predictive models suitable for stack-scale engineering analysis remain limited because high-fidelity computational fluid dynamics models are computationally expensive, whereas many reduced-order models lack comprehensive experimental validation. This study develops a one-dimensional physics-based electrochemical model for predicting the electrical and hydrogen production performance of a commercial 10-cell PEMWE stack. The model incorporates reversible voltage, activation overvoltage, ohmic losses, and concentration polarization while maintaining low computational cost. Experimental validation was performed at 80 °C over a current density range of 150–600 mA cm^{-2}. The proposed model achieved average relative errors of 0.67% for stack voltage and 3.52% for hydrogen production rate, demonstrating excellent agreement with experimental measurements. The validated model was further employed to evaluate electrical power consumption, specific energy consumption (SEC), and power-to-hydrogen conversion efficiency under varying operating conditions. The results reveal the trade-off between hydrogen production and energy conversion efficiency as current density increases. Owing to its high predictive accuracy and computational efficiency, the proposed framework provides a practical engineering tool for PEMWE performance assessment, renewable energy integration, power-to-hydrogen system analysis, and renewable power system planning and operation.
14:15-14:30	**ME015**	Three-Dimensional CFD Investigation of Membrane Thickness Effects on Electrochemical Performance of Proton Exchange Membrane Water

		Electrolyzers for Renewable Energy Storage Applications ***Siripat Rattanaphan, Mahidol University, Thailand*** ABSTRACT- The increasing integration of renewable energy sources has created a growing demand for efficient energy storage technologies capable of improving grid flexibility and renewable energy utilization. Proton exchange membrane water electrolyzers (PEMWEs) have emerged as a promising Power-to-Hydrogen (P2H) technology by converting surplus electrical energy into green hydrogen. This study develops a three-dimensional computational fluid dynamics (CFD) model to investigate the effects of commercially available Nafion membranes with different thicknesses on PEMWE performance. The model incorporates fluid flow, species transport, heat transfer, charge transport, and electrochemical reactions and is validated against experimental polarization data, yielding an average prediction error of 7.55%. The validated model is employed to evaluate the electrochemical performance and hydrogen transport characteristics of Nafion 115, Nafion 117, Nafion 211, and Nafion 212 membranes. The results demonstrate that reducing membrane thickness decreases membrane ohmic resistance, enhances proton transport, and increases hydrogen production. Among the investigated membranes, Nafion 211 achieves the highest performance, delivering a current density of approximately 3.1 A cm^{-2} at 2.25 V, compared with 2.0 A cm^{-2} for Nafion 117, corresponding to an improvement of nearly 55%. These findings provide engineering guidance for designing high-efficiency PEMWEs to support renewable energy storage, Power-to-Hydrogen systems, and future smart-grid applications.
14:30-14:45	**ME018**	Knowledge-Graph-Assisted Conflict Detection and Repair for Multi-Stage Cooling-Water Intake Filtration Configurations ***Peiyan Pan, Zhejiang University, China*** ABSTRACT- Reliable cooling-water intake is critical for coastal nuclear power plants, but early configuration design of multistage filtration systems often relies on site-specific experience and may overlook hidden conflicts among front interception, drum-screen control, and downstream protection. This paper proposes a knowledge-graph-assisted configuration reasoning method for intake filtration systems under mixed marine organism risks. Environmental risks, functional requirements, structure units, design parameters, constraint rules, historical cases, and evidence sources are represented in a site-oriented knowledge space. Constrained path search identifies risk-to parameter dependency paths, and path sensitivity is combined with QFD/AHP to prioritize configuration variables before historical case reuse. Rule reasoning then checks the reused scheme and produces traceable repair actions. In an anonymized engineering case, the method identifies 502 valid dependency paths from 15 source nodes to 24 target parameters and retrieves three similar cases with similarities of 0.920, 0.858, and 0.827. Direct case reuse leaves four hard conflicts, including oversized net-bag mesh, incomplete drum-screen control, missing bivalve collector backwash, and incomplete mixed-risk coordination. The proposed workflow

		reduces retained hard conflicts from 4 to 0 and records the risk, dependency path, triggered rule, repair action, and evidence source for each correction. The results show that site risk knowledge can be transformed into traceable, rule-consistent candidate configurations for subsequent hydraulic simulation and optimization.
14:45-15:00	**ME019**	Experimental Validation of Conjugate Heat Transfer CFD Models for Passive Thermal Management of High-Power COB-LED Modules in Power Electronic Applications ***Chayanan Taypongsak, Mahidol University, Thailand*** ABSTRACT- Efficient thermal management is essential for ensuring the reliability, efficiency, and service life of modern power electronic systems, including high-power light-emitting diode (LED) modules, power converters, electric vehicle electronics, and electrical drive systems. This study develops and experimentally validates a conjugate heat transfer (CHT) computational fluid dynamics (CFD) framework to evaluate the thermal performance of a radial-fin heat sink under natural convection. Experimental measurements at heat inputs ranging from 5 to 15 W were used to validate the numerical model. The CFD predictions agreed closely with the experimental results, with deviations of 1.60–2.96% and an average error of 2.41%, confirming the model's accuracy and reliability. The simulations revealed buoyancy-driven airflow through the fin channels, producing a vertical thermal plume above the heat sink due to the chimney effect. Comparative analysis demonstrated that the laminar flow model provided the closest agreement with the experimental data, outperforming the turbulence models investigated. The validated CFD framework provides a reliable and computationally efficient tool for the design and optimization of passive cooling systems for COB-LED modules and other naturally cooled power electronic devices, thereby supporting the development of energy-efficient and reliable electrical and electronic systems.
15:00-15:15	**ME052**	Operational Flexibility of Grid-Connected Power-to-Ammonia Systems under Temporal Renewable Matching ***Luis A. Oroya, State University of Campinas (UNICAMP), Brazil*** ABSTRACT- Grid-connected power-to-ammonia (P2A) plants can operate as flexible electrical loads by adjusting their electricity consumption, but shorter-interval renewable matching may restrict this capability. This paper evaluates that effect through a three-stage optimization framework in which matching is applied to the electrolyzer system, while flexibility is measured as a deviation in total P2A electrical demand. A common reference design is obtained under hourly matching (HM) and then operated under no matching (NM), monthly matching (MM), and HM. From the MM and HM baselines, paired matching-relaxed and matching-compliant problems quantify sustained load-increase (INC) and load-decrease (DEC) flexibility from the same operating state while preserving the monthly ammonia-production requirement and terminal hydrogen inventory. Nine representative monthly scenarios and activation durations of 1, 4, 12, and 24~h are considered. For

		the reference design sized under HM, MM preserved the matching-relaxed flexibility across all evaluated durations and directions. Under HM, DEC retained 92.3-95.3% of the matching-relaxed flexibility, while INC retention increased from 66.6% at 1 h to 88.7% at 24 h despite decreasing absolute flexibility.
15:15-15:30	**ME040**	Coupled Thermodynamic–Structural Design of a Supercritical Hydrogen Composite Tank ***Xinyan Pei, Tsinghua University, China*** ABSTRACT- This paper presents a thermodynamic–structural conceptual design for a low-temperature supercritical hydrogen composite tank intended for a hundred-kilogram-class fixed-wing platform. The proposed architecture integrates an ultrathin metallic hydrogen-barrier liner, a carbon-fiber-reinforced polymer load-bearing overwrap, vacuum multilayer insulation, and a lightweight outer jacket. Thermophysical properties are evaluated consistently with the Leachman normal-hydrogen Helmholtz equation of state. At the selected storage state of 60 K and 12 MPa, the hydrogen density is 47.7946 kg/m³, and a geometric volume of approximately 219.98 L contains 10.514 kg of hydrogen theoretically. A preliminary thermal-soak model for a sealed 220 L tank with 30 mm insulation and an effective thermal conductivity of 0.008 W/(m·K) predicts asymptotic warm-up toward 298.15 K and an equilibrium pressure of approximately 94.72 MPa; the corresponding real-gas full-warm-up pressure at 300 K is 95.31 MPa. These values are treated as thermodynamic boundaries rather than structural design or burst pressures. First-order structural scaling shows that the reference pressure strongly controls composite thickness and mass: for R = 0.28 m and an effective composite strength of 2.5 GPa, increasing the reference pressure from 35 to approximately 100 MPa raises the theoretical overwrap mass from 17.43 to about 49.8 kg. Medium-level comparison indicates that the 60 K/12 MPa state reduces the theoretical 10 kg storage volume by about 51.5% and 18.3% relative to 35 and 70 MPa gaseous hydrogen at 300 K, respectively. The results support pressure-level separation and controlled-pressure design as key elements for lightweight cryogenic hydrogen storage.

ORAL SESSION 2

Oral Session 2: Vibration Suppression and Nonlinear Dynamics Modeling and Control Methods

Chairperson: Assoc. Prof. Asnor Juraiza Ishak, Universiti Putra Malaysia, Malaysia

November 15, 2026 (Sun. GMT+9) **13:30-15:15**	**Kings Hall III-14F**

Time	Paper ID	Speech Title & Presenter
13:30-13:45	**ME017**	Finite Element Investigation of Tread Depth Effects on Impact-Induced Vibration and Structure-Borne Noise in Agricultural Off-Road Tires ***Siwakorn Phakdee, Mahidol University, Thailand*** ABSTRACT- Tire-road interaction is a major source of structure-borne noise and vibration in heavy-duty off-road vehicles, particularly when traversing rigid obstacles. This study investigates the influence of tread depth on transient impact vibration using a three-dimensional nonlinear finite element model of an 8.3–20 agricultural tire developed in MSC Dytran. Three tread configurations (36 mm, 27 mm, and 18 mm) were evaluated under identical rolling conditions over a rigid semi-cylindrical cleat. The transient dynamic responses were analyzed in both the time and frequency domains to assess the effects of tread-depth reduction on impact force, structural deformation, and vibration transmission. The results show that decreasing tread depth increases the peak vertical contact force from 7,437 N to 7,567 N and the wheel-hub displacement from 21.6 mm to 22.3 mm, indicating increased structural stiffness and reduced impact absorption. Frequency-domain analysis further reveals that the 18 mm tread configuration significantly amplifies vibration energy within the 10–30 Hz range, which is associated with whole-body vibration and low-frequency structure-borne noise. The findings demonstrate that optimizing tread depth can effectively improve vibration isolation and reduce impact-induced excitation at the tire-road interface. This study provides an efficient computational framework for tire design optimization and contributes to Automotive Engineering, particularly in Acoustics and Noise Control, by supporting the development of quieter and more comfortable heavy-duty off-road vehicles.
13:45-14:00	**ME023-A**	Physics-Constrained Neural Network-Based Correction of Newman's Approximation and Prediction of Second-Order Slowly Varying Wave Loads ***Fei Xu, Harbin Engineering University, China*** ABSTRACT- Accurate and efficient prediction of second-order low-frequency hydrodynamic loads on large floating structures is important for the analysis of slow-drift motions and the design of mooring systems. The Newman approximation is an efficient method for predicting second-order slowly varying wave loads by estimating the off-diagonal terms of the difference-frequency quadratic transfer function (QTF) from its diagonal terms. However, its prediction error can become significant when off-diagonal difference-frequency coupling is strong. To address this issue, a physics-constrained neural network (PCNN)-based correction method for the

		Newman approximation is proposed. The method takes the Newman approximation as the baseline and constructs a correction factor within the near-diagonal small-difference-frequency region to learn the deviation of the exact difference-frequency QTF from the Newman baseline. Diagonal consistency, exchange symmetry, and frequency-domain smoothness constraints are further incorporated. An analytical second-order slowly varying pressure case under a PM spectrum is adopted as the validation benchmark. The corrected QTF is substituted into the second-order pressure double-summation formulation, and the low-pass slowly varying pressure component is extracted and compared with the analytical solution and the Newman approximation. Results show that the proposed PCNN correction effectively compensates for the underestimation of fluctuation amplitudes by the Newman approximation. At the baseline correction bandwidth, the relative root-mean-square errors at three depth locations are reduced by 47.23%, 61.17%, and 67.03%, respectively, compared with the Newman approximation. By further introducing frequency-band-enhanced features, the model achieves improved representation of local variations across different frequency ranges. Sensitivity analyses of the correction bandwidth and training-sample ratio further demonstrate the stability of the proposed method.
14:00-14:15	**ME024-A**	Research on Multi-type Band Gaps and Vibration Reduction Characteristics of Three-Dimensional Hierarchical Phononic Crystals ***Jiping Jing, Harbin Engineering University, China*** ABSTRACT- Inspired by hierarchical multi-periodic architectures commonly found in nature, this study proposes a three-dimensional (3D) hierarchical phononic crystal for effective vibration suppression and noise reduction in vehicle applications. The design aims to attenuate low-frequency vibrations that are major contributors to cabin noise and structural fatigue in automobiles. The proposed 3D hierarchical phononic crystal features variable cross-section cylinders with periodically varying radii as the fundamental micro-unit cells, which are periodically arranged to construct the macroscopic unit cell. Dispersion curves are computed using finite element numerical simulations incorporating Bloch periodic boundary conditions. The calculated energy band structure reveals both tortuous and relatively flat band curves, which are respectively associated with the vibration modes of the macro- and micro-unit cells. A systematic parametric study is conducted to investigate the influence of key structural parameters on the formation and evolution of these two types of band gaps. Key findings demonstrate that the vibration characteristics of the macro- and micro-unit cells play a pivotal role in governing the diverse band gap behaviors. Furthermore, the vibration attenuation performance of a 2×2×2 periodic array is evaluated across multiple excitation directions and positions. Effective attenuation is observed even with a limited number of periods, confirming the practical feasibility for integration into automotive panels and chassis components. To validate the numerical predictions, an experimental prototype is fabricated using additive manufacturing (3D printing), and vibration transmission tests are performed. The measured vibration suppression performance shows good agreement with the numerical results. This study not only advances the fundamental understanding of band gap mechanisms in hierarchical periodic structures but also provides practical design guidelines for tailoring band gaps through

		substructure modulation. The demonstrated lightweight and tunable vibration attenuation capabilities offer promising potential for automotive body panels, floor structures, and suspension systems.
14:15-14:30	**ME027-A**	Multi-Source Preview Perception and Adaptive MPC Control for a Vehicle-Mounted Vibration Isolation Platform under Complex Road Conditions ***YuKun Shi, Harbin Engineering University, China*** ABSTRACT- To address the adverse effects of road-induced disturbances on the stable operation of onboard equipment and the vibration isolation performance of vehicle-mounted platforms under complex road conditions, a model predictive control (MPC) method integrating multi-source road preview perception and operating-condition-adaptive weight scheduling is proposed. First, multi-source sensors are employed to acquire information on the road surface ahead of the vehicle. Through spatiotemporal alignment, road elevation reconstruction, typical road-event recognition, and preview-error modeling, a road preview disturbance sequence suitable for the MPC prediction horizon is constructed, thereby providing feedforward road information for vibration control. Second, considering that variations in vehicle speed lead to changes in preview time, prediction horizon, front-to-rear wheel input delay, and road excitation frequency, the coupled relationships among vehicle speed, preview distance, prediction horizon, and control performance are analyzed. Based on these relationships, a speed-adaptive preview MPC strategy is developed to enhance controller adaptability over a wide range of vehicle speeds and combined road conditions. Furthermore, the effects of MPC weighting parameters on platform acceleration, platform displacement, dynamic tire load, actuator energy consumption, and control smoothness are investigated. An operating-condition-based weight optimization and scheduling mechanism is then established to achieve coordinated trade-offs among multiple control objectives. Finally, simulation and hardware-in-the-loop (HiL) test platforms are developed to evaluate the proposed method under different vehicle speeds and complex road conditions. The results demonstrate that the proposed multi-source preview perception and adaptive MPC method can effectively improve the vibration isolation performance and operating-condition adaptability of the vehicle-mounted vibration isolation platform, providing a feasible solution for active vibration control of onboard equipment under complex road conditions.
14:30-14:45	**ME037**	Effects of Needle Geometry on Jet–Bucket Interaction and Dominant Dynamics in a Pelton Turbine ***Anqi Tang, Zhejiang University, China*** ABSTRACT- Pelton turbines are hydraulic machines that convert high-head hydraulic energy into mechanical power through the interaction between a high-speed free jet and rotating buckets. Although injector geometry and needle opening have been widely investigated, the hydrodynamic effects of changing needle geometry while maintaining the same opening area have received limited attention. Accordingly, this study compares two needle

		geometries, Needle A and Needle B, under two identical flow-area conditions, while keeping the nozzle casing and runner unchanged. Transient homogeneous water–air CFD is employed to investigate the internal flow, and extended dynamic mode decomposition (EDMD) is applied to the transient bucket-surface pressure field. Compared with Needle A, Needle B causes less disturbance to the internal injector flow as the opening changes, resulting in lower hydraulic dissipation and a more stable efficiency response. Needle B also produces a more contracted jet, reducing the extent of the air–water interface before the jet reaches the runner. The EDMD reconstruction achieves R^2>0.98 for all cases. The modal energy distribution reveals a consistent hierarchy of dominant pressure structures despite variations in geometry and opening. The first dominant dynamic mode forms a broad coherent structure extending from the bucket splitter toward the cutout region, corresponding to the jet-impact and water-film redistribution path. Higher-order modes progressively introduce secondary branches and finer localized pressure structures. The results demonstrate that needle geometry influences the internal injector flow, which subsequently alters the jet characteristics and jet–bucket interaction, thereby affecting the hydraulic performance.
14:45-15:00	**ME039**	*Dynamic Modeling of Combined Helical Gear Transmission Systems with Clutch Impacts* ***Yan Xiaoyan, Zhejiang University, China*** ABSTRACT- Combined helical gear transmission systems (CHGTSs) merge multi-source power onto a shared output shaft through a wet clutch, so clutch engagement and disengagement introduce friction torque and spline impacts that are inherently coupled with gear meshing and nonlinear bearing forces. Revealing how these clutch-induced excitations govern the dynamic characteristics of the CHGTS is essential for its reliable operation, yet remains insufficiently addressed. This study develops a coupled dynamic model with dual-state boundaries that explicitly captures the friction torque during engagement and the spline-friction plate impacts when disengagement. The results reveal a fundamental distinction between dual-engine merging and single-side input: engagement amplifies dynamic transmission error and meshing force fluctuations, although inertial smoothing narrows this gap at higher speeds; during disengagement, spline impacts generate broadband excitations that intensify with speed and tooth clearance. After engagement, vibration amplitude and frequency rise with speed toward chaotic behavior, while increased load torque effectively suppresses chaos, underscoring the necessity of clutch-state-aware dynamic design for CHGTSs.
15:00-15:15	**ME053**	Model Predictive Control Using State Estimation Based on Unscented Kalman Filter for 3-DOF Motion of Reusable Rockets ***Toru Morita, Osaka Institute of Technology, Japan*** ABSTRACT- With the rapid expansion of the space industry, reusable rockets

		have attracted significant attention. To achieve precise landing control, it is necessary to account the nonlinear dynamics associated with large attitude changes. Furthermore, when it is difficult to accurately measure all system states during flight, incorporating a state estimation technique into the control system becomes essential. This study proposes a control system design method that combines state estimation based on the Unscented Kalman Filter(UKF) with Nonlinear Model Predictive Control(NMPC). The NMPC solution is updated using the C/GMRES method, which enables high-speed numerical optimization suitable for real-time applications. The proposed method is applied to the vertical-plane motion of a reusable rocket while accounting for the continuous variation in mass caused by propellant consumption. To evaluate the effectiveness of the proposed method, numerical simulations of a landing sequence are conducted. The simulation results demonstrate that the UKF successfully estimates the unmeasured states and the varying mass. In addition, the NMPC generates appropriate control inputs that guide the rocket to the target landing position and attitude. These results confirm the effectiveness of the proposed method.

ORAL SESSION 3

Oral Session 3: Battery Health Management and Coordinated Scheduling Techniques for Multi-Type Energy Storage

Chairperson: Prof. Tomoaki Hashimoto, Osaka Institute of Technology, Japan

November 15, 2026 (Sun. GMT+9) **16:00-17:30**	**Kings Hall II-14F**

Time	Paper ID	Speech Title & Presenter
16:00-16:15	**ME056-A**	Analysis of Abnormal Cell Behavior Using Cell Balancing History and Heat Generation Characteristics in a MATLAB/Simulink-Based Battery Module Soonwon Baek, Kookmin University, South Korea ABSTRACT- Lithium-ion batteries for electric vehicles consist of numerous cells connected in series and parallel, and differences in the degree of degradation and electrical characteristics of individual cells can affect the performance and safety of the battery system. In particular, cells with reduced capacity or increased internal resistance may exhibit voltage characteristics different from normal cells during charging and discharging, which may lead to repeated cell balancing operations for specific cells. Conventional Battery Management Systems (BMS) perform cell balancing to mitigate voltage imbalances between cells however, the operational history generated during the balancing process is primarily used for control purposes and is not sufficiently utilized as diagnostic information for evaluating cell status. In this study, we investigated whether balancing history can be used as operational information indicating changes in cell status by comprehensively analyzing the cumulative number of cell balancing operations and heat generation characteristics during charging. We implemented an equivalent circuit-based battery module and a passive cell balancing algorithm in MATLAB/Simulink and performed charging simulations under conditions including normal cells and degraded abnormal cells. Based on the simulation results, we analyzed the relationship between repetitive cell imbalance and thermal behavior by comparing the equilibrium behavior and heat generation rates for each cell. The research results suggest that interpreting cell equilibrium history and thermal characteristics together can provide additional diagnostic information for identifying changes in abnormal cell states by utilizing data obtainable from existing BMSs. This study can serve as foundational data for the development of early abnormal cell detection and BMS-based diagnostic methods using limited sensor information.
16:15-16:30	**ME057-A**	Effects of Pulse Waveform and Frequency on Lithium-Ion Battery Charging Characteristics ***Younggill Son, Kookmin University, South Korea*** ABSTRACT- Pulse-based charging has emerged as a promising approach for developing fast-charging protocols for lithium-ion batteries. However, the effects of pulse-current waveform and frequency on voltage response and

		thermal behavior remain insufficiently understood, particularly regarding their implications for battery stress and long-term degradation. This study experimentally investigates the influence of pulse parameters on lithium-ion battery charging characteristics under controlled operating conditions. Electrochemical impedance spectroscopy (EIS) was employed to support pulse-frequency selection. Four charging waveforms, including positive pulse current (PPC), pulse amplitude modulation (PAM), positive constant-current pulse charging (PCCC), and negative pulse charging (NPC), were evaluated at frequencies of 0.05, 0.5, and 5 Hz, with a nominal duty ratio of 0.5 and an approximately equivalent mean charging current of 1C. Charging duration, terminal-voltage response, and surface-temperature characteristics were analyzed under a fixed charge-input target. The experimental results revealed that current waveform selection had a more pronounced influence on thermal behavior than pulse-frequency variation. In particular, the waveforms exhibited distinct temperature-rise rates, times to peak temperature, and thermal responses during the remaining charging period. PAM exhibited an early temperature peak followed by a gradual temperature decrease before charging completion, whereas other waveforms showed different temperature evolution patterns. NPC generally produced higher peak temperatures and larger voltage fluctuations, while PCCC exhibited relatively low peak temperatures with spatial temperature differences. Increasing pulse frequency reduced voltage fluctuations, although its influence on peak temperature was comparatively limited and waveform-dependent. These findings demonstrate that maximum temperature alone is insufficient to characterize thermal loading during pulse charging, emphasizing the importance of temperature evolution and thermal exposure throughout the charging process. Further investigation is required to determine how these waveform-dependent thermal characteristics influence long-term battery degradation. This study provides experimental insights into pulse-parameter selection for future fast-charging protocol development.
16:30-16:45	**ME602**	Degradation Analysis of Inverter Components Based on Environmental Factors ***Jae-Uk Sim, Korea National University of Transportation, South Korea*** ABSTRACT- Inverters are widely used in applications such as photovoltaic (PV) power generation and automotive systems, and during long-term operation they are continuously exposed to outdoor environments, which accelerates the degradation of components such as IGBTs and DC-link capacitors. The outdoor environmental factors driving this acceleration include average temperature, temperature variation and humidity. Establishing an effective maintenance strategy requires the degradation contribution of each factor to be identified using a unified quantitative metric; however, prior studies report lifetime in their own testing units, so no such comparison has been performed. This paper compares the degradation contributions of the outdoor environmental factors for IGBTs and DC-link capacitors. Degradation data and accelerated life models from prior studies are used to derive the Acceleration Factor (AF) for each factor and to rank the contributions for each component. Temperature variation is the most dominant factor for IGBTs, with an average AF of 23.07, whereas average temperature is dominant for DC-link capacitors, with an average AF of 7.65. The results provide a quantitative basis for prioritizing inverter maintenance.

16:45-17:00	**ME603**	Loss-Aware Capacity and Dispatch Co-Optimization for Hybrid AC/DC Multi-Type Building Campuses ***Tieniu Zhao, Southeast University, China*** ABSTRACT- For multi-type building campuses with PV generation, battery/thermal storage, and AC/DC EV charging, we propose a loss-aware optimization frame-work that coordinates the capacity planning and dispatch of hybrid AC/DC cen-tral chillers. A Hiking Optimization Algorithm (HOA) searches equipment ca-pacities, while an 8760-h piecewise-linear mixed-integer linear programming (PWL-MILP) model evaluates annual operation using piecewise-linearized load-rate-dependent conversion and distribution losses. Identical cooling and heating coefficients of performance are assigned to AC- and DC-supplied chillers to iso-late capacity-allocation and electrical-path effects. A mixed-use campus in Wuxi is used as a case study. Across five independent HOA runs per scenario, the mixed design yields a mean EAC of 616,230 ± 520 yuan/year, indicating stable optimization performance. Based on the best run of each scenario, the mixed de-sign achieves an EAC of 615,550 yuan/year, which is 3.24%, 2.56%, and 6.60% lower than the best all-DC, all-AC, and no-thermal-storage results, respectively. Its best-run configuration has building-specific DC chiller shares of 34.22%–65.85% and a total path loss of 68.93 MWh/year. These results demonstrate that building-specific AC/DC capacity allocation and loss-aware full-year coordina-tion can improve the economy and energy efficiency of multi-type campus en-ergy systems.
17:00-17:15	**ME604**	Rolling 24-h Electricity Load Forecasting across HPC Capacity Expansion: Standardization and Conformal Intervals ***KeXin Guo, Southeast University, China*** ABSTRACT- Data centers are among the fastest-growing electricity loads in modern power systems, yet public studies of facility-level load fore-casting remain scarce. Using minute-level Energy Systems Integration Facility (ESIF) records spanning a 2.40-fold rise in mean daily load, we evaluate rolling 24-h forecasts across capacity expansion. Eight point forecasters establish the benchmark: a temporal convolutional network (TCN) has the lowest aggregate errors, whereas persistence is more ac-curate at leads 1–6. For long short-term memory (LSTM), TCN, and a patch-based time-series transformer (PatchTST), replacing per-window with training-period standardization raises mean absolute error (MAE) by 5.9–12.1%, more than the differences among the models. With the TCN forecasts fixed, 14-day rolling split conformal prediction (SCP) and adaptive conformal inference (ACI) more than halve the static SCP in-terval width at about 91.3% marginal coverage; ACI is a further 7%narrower. Thus, standardization has the larger effect on point accuracy among the tested sequence models, while ACI gives the narrowest inter-vals at comparable coverage.
17:15-17:30	**ME605**	Optimal Sizing and Operation of Multi-Type Energy Storage Systems in an Integrated Energy System with Coordinated Scheduling of Flexible Loads

Xiaoya Geng, Southeast University, China

ABSTRACT- This paper develops a two-stage optimization framework for the planning and operation of a hospital-campus integrated energy system incorporating electrical, cold, and heat storage, coordinated electric vehicle (EV) charging, and flexible air-conditioning loads. The model minimizes the equivalent annual life-cycle cost (EALCC) subject to energy-balance, equipment-operation, storage-operation, and point-of-common-coupling power-fluctuation constraints. Four scenarios are evaluated: no flexibility, air-conditioning flexibility, coordinated EV charging, and coordinated flexibility. In the planning stage, storage capacities and hourly operation are jointly optimized. In the operational stage, the capacities optimized under coordinated flexibility are fixed to compare PV accommodation across the four scenarios. Compared with no flexibility, coordinated flexibility reduces electrical, cold, and heat storage capacities by 38.67%, 28.53%, and 39.67%, respectively, while decreasing EALCC by 13.93%. Under fixed capacities, PV accommodation increases from 90.5% to 98.7%. EV charging provides the primary load-shifting contribution, while air-conditioning flexibility offers complementary regulation.

ORAL SESSION 4

Oral Session 4: Data-Driven Predictive Scheduling Methods for Manufacturing Processes and Energy Systems

Chairperson: Assoc. Prof. Azura Che Soh, Universiti Putra Malaysia, Malaysia

November 15, 2026 (Sun. GMT+9)
16:00-17:30

Kings Hall III-14F

Time	Paper ID	Speech Title & Presenter
16:00-16:15	**ME026-A**	Vibration Characteristics and Thermoelastic Damping of Circular Plates under General Elastic Boundary Constraints ***Yukun Qin, College of Aerospace Engineering, Harbin Engineering University, China*** ABSTRACT- Accurate prediction of the vibration characteristics of circular plates is essential for the dynamic design and quality-factor evaluation of micro- and nanoelectromechanical resonators. However, classical analytical solutions are generally restricted to ideal boundary conditions and often become difficult to extend to elastic constraints and non-axisymmetric modes. This study develops a unified semi-analytical framework for the free-vibration and thermoelastic-damping analysis of thin circular plates with arbitrary edge restraints. Based on Kirchhoff plate theory, the kinetic energy, bending strain energy, and energy stored in the boundary springs are formulated, and the governing equations of motion are derived using Hamilton's principle and the Rayleigh-Ritz method. The transverse displacement is expanded in Jacobi orthogonal polynomials in the radial direction and Fourier series in the circumferential direction. Uniformly distributed linear and rotational springs are introduced along the plate edge, enabling clamped, simply supported, free, and intermediate elastic boundaries to be represented within the same formulation. The resulting generalized eigenvalue problem provides the natural frequencies and mode shapes required for subsequent thermoelastic analysis. Convergence studies demonstrate that the proposed displacement expansion accurately captures both axisymmetric and non-axisymmetric vibration modes with relatively few terms. The calculated dimensionless frequencies under classical boundary conditions agree closely with published results, confirming the validity of the dynamic model. Parametric results show that variations in boundary stiffness can significantly modify the natural frequencies, mode shapes, and strain-energy distributions, with linear spring stiffness exerting a stronger influence than rotational spring stiffness. The obtained modal solutions are further coupled with a three-dimensional heat-conduction model to evaluate thermoelastic damping. Comparisons with finite element simulations show that the complete framework maintains high accuracy while reducing computation time by more than 97%. The proposed approach therefore provides an efficient tool for investigating boundary-dependent vibration behavior and optimizing the dynamic performance of circular-plate resonators.

16:15-16:30	**ME031**	Metaheuristic Optimization Algorithms for Constrained Soot-Blowing Sequence Planning in Coal-Fired Boilers ***Azura Che Soh, Universiti Putra Malaysia, Malaysia*** ABSTRACT- This paper presents a simulation framework for benchmarking metaheuristic optimization algorithms for soot-blowing sequence planning in ultra-supercritical coal-fired boilers. The framework employs a load-independent Cleanliness Level (CL) and a rolling-horizon simulation to evaluate algorithms under consistent operational constraints. Three algorithms, Simulated Annealing (SA), Non-dominated Sorting Genetic Algorithm II (NSGA-II), and Ant Colony Optimization (ACO), are compared based on steam consumption, thermal gain, and cleanliness imbalance improvement. Results show that SA achieves the highest thermal gain while maintaining a favourable balance between thermal performance and steam usage. NSGA-II minimises steam consumption but provides lower thermal gains, whereas ACO improves cleanliness imbalance in some cases but does not consistently outperform SA. Overall, the findings demonstrate that SA is the most effective approach for soot-blowing sequence planning, highlighting the potential of AI-based metaheuristic optimization for intelligent industrial boiler control and decision support.
16:30-16:45	**ME036**	Data-Driven Anomaly Detection in Gas Turbine Using Mahalanobis Distance and Cluster-Based Preprocessing ***Asnor Juraiza Ishak, Universiti Putra Malaysia, Malaysia*** ABSTRACT- Combined-cycle gas turbines are widely used for power generation, but abnormal operating conditions and variations in process parameters can affect system reliability and performance. This research presents a data-driven framework for detecting abnormal operating conditions in gas turbine performance. The proposed methodology involves preprocessing the data using Z-scores and K-means clustering, followed by multivariate anomaly detection using Mahalanobis distance. A data point is regarded as an anomaly if it deviates sufficiently from the established distribution of normal gas turbine behavior while accounting for the influence of other parameters. The effectiveness of the data-cleaning process is assessed based on Mean Mahalanobis Distance (MMD), Mean Absolute Error (MAE), and Root Mean Square Error (RMSE). The results show that the MMD for temperature across the compressor-to-combustor (T2-T3) decreased from 1.1724 to 1.1510, while that for temperature across the combustor-to-turbine (T3-T4) decreased from 1.1697 to 1.1467. For T2-T3, MAE and RMSE decreased from 0.1285 to 0.1117 and 0.1944 to 0.1574, respectively. Similarly, T3-T4 reduced MAE from 0.1728 to 0.1487 and RMSE from 0.2454 to 0.2139. For pressure across the combustor-to-turbine (P3-P4), RMSE decreased from 2.1839 to 2.1409, although MAE increased slightly. Overall, the results demonstrate that the proposed framework effectively identifies anomalous observations and improves the consistency of gas turbine operating data, particularly for temperature-related relationships.
16:45-17:00	**ME042**	Smart Vacuum-Cleaning Robot with AI-Based Suction Control and Navigation ***Jover Macanas Gencianos, Mapua University, Philippines***

		ABSTRACT- This paper describes the design, implementation, and experimental evaluation of an autonomous vacuum-cleaning robot intended for controlled indoor and office environments. The robot platform integrates a mecanum-wheeled omnidirectional drive, an Arduino Mega microcontroller for the control of low-level functions, a Raspberry Pi single-board computer for image processing, a Jetson Orin Nano AI computer for high-level navigation, LiDAR (light detection and ranging) remote sensor, ultrasonic sensors, encoder feedback, PID control, and PWM control for the vacuum motor. The work was executed in three stages: design and simulation, prototype integration, and experimentation. All of these steps were conducted in a controlled environment. The cleaning tests were conducted on carpet and concrete surfaces with three cleaning duty cycles (40%, 60%, and 80%) and a range of robot speeds. For the carpet surface, speed was the most significant factor in cleaning performance. At very slow robot speeds, the robot produced approximately 52% dust-removal efficiency. Ultra Very Slow was approximately 47%, and Slow was around the 35% limit, while Normal, Fast, and Very Fast speeds were below this limit. The cleaning duty cycles did not have a statistically significant effect (F = 1.48, p = .151). The experiments demonstrated that, in the case of concrete surfaces, the effect of suction power is significant (F = 66.06, p < .001), with about 53–56% efficiency from the 80% cleaning duty cycle. This was approximately 12% higher than the 40% cleaning duty cycle. The tests using AI for floor observation demonstrated a 100% pass rate in 250 recorded observations, while no dust removal was observed in tested carpet and concrete at the 30 mm position. Finally, the experiments for obstacle avoidance were performed in office navigation tasks, and they demonstrated 100% successful obstacle avoidance using LiDAR and ultrasonic sensors.
17:00-17:15	**ME608**	Wind–Solar Complementarity and System Value under High-Altitude Conditions: Evidence from Tibet ***Lun Li, Southeast University, China*** ABSTRACT- Resource abundance and wind–solar correlation are widely used to re-newable-energy planning. However, the effect of high-altitude complex climate conditions on renewable energy power and the mechanisms governing the con-version of resources into systemic value remain unclear. This study evaluates that distinction for 1,809 valid 0.25 deg x 0.25 deg grid across Tibet using hourly 2025 meteorological profiles and a common normalized load. Altitude- and cli-mate-related corrections are applied to PV conversion, wind-turbine output, and battery availability, after which least-cost PV-battery and PV-wind-battery sys-tems are optimized subject to hourly energy balance, cyclic state of charge, and LPSP <= 0.001. Statistical complementarity is measured by the complementarity index (CI), while optimized storage value (OSV) and economic complementarity value (ECV) quantify the relative reductions in battery capacity and LCOE. Across all cells, including zero-value outcomes, CI has negligible linear associa-tions with OSV (r = 0.0186, R2 = 0.00035) and ECV (r = 0.0319, R2 = 0.00102). OSV is strongly associated with ECV (r = 0.773, R2 = 0.597), whereas corrected wind

		capacity factor explains only 8.9% and 7.8% of their spatial variation. Thus, temporal anti-correlation alone is an insufficient proxy for system value; under the adopted load, reliability, and cost assumptions, lower optimized battery ca-pacity is associated with lower modeled electricity cost.
17:15-17:30	**ME609**	Machine Learning-Based Energy Consumption Forecasting for Energy Management in a Food Processing Facility in Thailand ***PRIYAPORN RATSAME, Shibaura Institute of Technology, Japan*** ABSTRACT- Based on factors related to energy consumption in the food industry in Thailand, including production processes, machine operation, environmental conditions, operating periods, and production volume, these factors affect fluctuations in energy consumption. Therefore, energy consumption forecasting is important for energy demand planning, operational control, and improving energy management efficiency. This research presents a machine learning-based framework for forecasting energy consumption to support energy management in food processing facilities. The framework uses historical energy consumption data together with production data, machine operation data, environmental data, time-related factors, and electricity prices in Thailand. Actual data from a food industrial facility in Thailand were used as a case study. The research compares three models: linear regression, random forest, and XGBoost. The data were divided chronologically, with data from 2021–2024 used for model training and data from 2025 used for testing. Model performance was evaluated using MAE, RMSE, MAPE, sMAPE, and R^2. The testing results showed that Linear Regression achieved the lowest RMSE and highest R^2, whereas Random Forest achieved the lowest MAE, MAPE, and sMAPE. Considering the overall balance of the error metrics, Random Forest was selected for long-term forecasting. Feature importance analysis showed that Energy_t-24 and Production_Rate were important variables for Random Forest forecasting. These results reflect that historical energy consumption patterns and production levels play important roles in energy consumption in industrial facilities. The proposed forecasting framework can provide scenario- based information to support energy demand planning, operational planning, energy efficiency improvement, and the development of energy management systems in industrial facilities.

POSTER DISPLAY

November 15, 2026 (Sun. GMT+9) 13:30-17:30	Kings Hall II-14F

Paper ID	Paper Title & Authors
ME035	Experimental Evaluation of SOC Estimation Performance at Different Aging Stages of a 12V Lithium Titanate Battery ***Guenbae Hong, Korea Automotive Technology Institute (KATECH), Republic of Korea*** ABSTRACT- With the increasing electrification of eco friendly mobility and the advancement of automotive power systems, reliable state of charge estimation over long term battery operation has become increasingly important. Model based SOC estimators are generally developed using battery characteristics identified at the beginning of life, although these characteristics may change with aging and cause mismatch between the initial model and the aged battery. In this study, the SOC estimation performance of a 12V lithium titanate battery was experimentally evaluated during room temperature cycle aging. Periodic capacity and SOC versus open circuit voltage tests were conducted up to 3,200 cycles, and an SOC estimation model developed from the initial battery characteristics was applied to all aging stages without model reidentification or parameter updating. After 3,200 cycles, the battery retained 97.92 percent of its initial discharge capacity. The SOC estimation mean absolute error remained below 2.8 percent for the capacity tests and below 2.4 percent for the SOC versus open circuit voltage tests. The limited variation in estimation error indicates that the initially calibrated model maintained consistent performance over the investigated aging range, supporting assessment of its long term applicability and potential recalibration requirements.

ONLINE SESSION 1

November 15, 2026 (Sun. GMT+9)	**Zoom ID: 817 1417 2996**
15:00-17:15	Link: https://us02web.zoom.us/j/81714172996

Online Session 1: Multiphysics Modeling and Intelligent Diagnostic Techniques for Renewable Energy and Mechanical Systems

Chairperson: Assoc. Prof. Raul Duarte Salgueiral Gomes Campilho, ISEP – School of Engineering, Porto, Portugal

Time	Paper ID	Speech Title & Presenter
15:00-15:15	**ME009**	MP-RAN: Multi-Peak Tracking with Temporal Attention for MPPT under Partial Shading Conditions ***Xiaofeng Wu, Guangzhou Songtian Polytechnic College, China*** ABSTRACT- Maximum Power Point Tracking (MPPT) under partial shading conditions (PSC) remains a critical challenge in photovoltaic systems due to the presence of multiple local power peaks. Conventional hill-climbing algorithms often converge to local optima, resulting in significant power losses. This paper proposes MP-RAN (Multi-Peak tracking with temporal Attention Network), a novel reinforcement learning-based MPPT algorithm that leverages temporal attention mechanisms to capture power variation trends and guide tracking toward the global maximum. MP-RAN employs a physics-guided temporal encoder with multi-head self-attention, coupled with a soft-switching mechanism that balances global exploration and local refinement. We establish a comprehensive benchmark comprising five partial shading scenarios with progressively increasing complexity. Experimental results demonstrate that MP-RAN achieves an average tracking efficiency of 98.6% and a Global Maximum Power Point Hit Rate of 83.3%, outperforming Perturb and Observe (95.5%), Incremental Conductance (95.2%), and Deep Deterministic Policy Gradient (97.1%) baselines. In severe shading scenarios, MP-RAN achieves four times improvement in GMPP hit rate over conventional methods.
15:15-15:30	**ME032**	Residual-State Sensitivity in a Dripping-Faucet Fold Model: Image Analysis and Numerical Verification ***Yucan Feng, Shanghai Jiao Tong University, China*** ABSTRACT- Residual deformation and motion can influence successive drops, yet a geometric instability event in a reduced model need not represent physical breakup. This study combines image analysis of an archived dripping-faucet sequence with numerical event diagnostics for a damped fold model under continued supply. Three visually reviewed macroscopic detachments were identified in 398 exported frames; separation indices varied by at most one frame across three segmentation thresholds. The measured extension record describes intervening remnant evolution. In controlled model comparisons, reversing initial velocity at fixed magnitude and otherwise

		identical conditions changed pre-fold crossing outcomes despite identical initial energy. Of 176 supply–damping slices on the sampled grid, 21 showed nonmonotonic crossing responses to initial velocity. A separate case crossed the moving reference saddle with negative modal velocity, demonstrating that this event alone does not establish outward escape or pinch-off. Analytical limits, energy balances, independent integrators, and event-guard sensitivity were checked. The resulting workflow identifies state information and event definitions needed for residual-dynamics studies. Physical calibration and independent breakup measurements remain necessary to connect the uncalibrated model to secondary-drop prediction.
15:30-15:45	**ME043**	Thorium-Based Nuclear Energy Systems: Fuel Cycles, Reactor Technologies, Sustainability, and a Deployment-Oriented Assessment ***Petronillo Daug Peligro, Mapua University, Philippines*** ABSTRACT- Thorium has gained increasing attention as a potential alternative nuclear fuel because of its greater natural abundance, superior fuel utilization capability, reduced production of long-lived radioactive waste, and enhanced proliferation resistance compared with conventional uranium fuel cycles. However, despite decades of research, commercial deployment remains limited due to technological, economic, and regulatory challenges. This paper presents a comprehensive review of thorium-based nuclear energy systems, focusing on thorium fuel cycle fundamentals, reactor technologies, neutronic performance, fuel cycle modeling, environmental sustainability, commercialization readiness, and deployment challenges. Comparative analyses between uranium, plutonium, and thorium fuel cycles are performed using key performance indicators, including neutron economy, conversion ratio, breeding performance, burnup capability, fuel utilization efficiency, radioactive waste generation, and technology readiness. Based on the reviewed literature, a deployment-oriented framework and strategic commercialization roadmap are proposed to facilitate the transition from conventional uranium-based reactors toward advanced thorium energy systems. The review demonstrates that molten salt reactors and advanced heavy water reactors provide the greatest long-term potential for sustainable thorium utilization, although continued advances in fuel reprocessing, materials engineering, licensing frameworks, and reactor demonstration projects remain essential for commercialization. The findings provide researchers, policymakers, and industry stakeholders with an integrated perspective for future development of thorium-based nuclear energy systems.
15:45-16:00	**ME022**	A Multi-Objective Digital Twin Framework for Sustainable Adaptive Drilling ***Asif Iqbal, Universiti Brunei Darussalam, Brunei*** ABSTRACT- This work proposes a physics-informed Multi-Objective Digital Twin (MODT) for sustainable adaptive drilling of Ti-6Al-4V and CFRP. The framework integrates governing process equations with experimentally validated knowledge to estimate the drilling state and generate material-specific, hole-by-hole adjustments to coolant condition, feed rate, and cutting

		speed. The decision hierarchy reflects the dominant process factors for each material, with feed rate playing a greater role in Ti-6Al-4V drilling and coolant selection dominating CFRP drilling. An experiment-based case study demonstrates the adaptive evolution of process parameters over five successive holes and evaluates the resulting sustainability and resilience indices. The results confirm that the proposed MODT improves both indices for the two materials, supporting transparent, physics-based decisions for sustainable drilling.
16:00-16:15	**ME049**	Nozzle Angle Optimization for Air-Jet Pavement Anti-Icing Based on Effective Heating Area ***Zhizhen Jiang, Zhejiang University, China*** ABSTRACT- Mean heat transfer alone does not determine the pavement area receiving sufficient heat for a prescribed anti-icing design criterion. We evaluated horizontal and downward nozzle angles using three-dimensional steady computational fluid dynamics and a quadratic response surface. Effective area was defined by an absorbed heat flux of at least 20 watts per square metre under dry, precipitation-free conditions, with a prescribed pavement temperature of 0.5 degrees Celsius and a crosswind of 4 metres per second. High-performance angle regions were mapped at allowable area losses of 1 percent, 2 percent and 5 percent relative to the largest area in the 35-case angle dataset, 46.930 square metres. These criteria retained 4, 9 and 19 of the 35 CFD configurations, respectively. The model fitted to 30 cases gave a root-mean-square error of 0.239 square metres for five additional validation cases. All five lay within the predicted 1 percent region, but only two met that criterion using CFD; all five met the 2 percent criterion. The continuous region boundaries remain model predictions, including portions outside the fitting convex hull. The regional approach supports angle selection for a stated coverage allowance; angle-tolerance and physical anti-icing tests are needed to assess its practical use.
16:15-16:30	**ME054**	Effects of Sample Length and Training Data Size on Bearing Fault Diagnosis ***Jingyao Yan, Xi'an Jiaotong–Liverpool University, China*** ABSTRACT- This study investigates the effects of sample length and training data quantity on bearing fault diagnosis performance and the relative performance of different models, addressing the difficulty of interpreting performance differences when these two factors are interrelated. Using the Paderborn bearing dataset, five splits are constructed with no overlap in physical bearing identities between the training and test sets. Four methods are compared under two separate constraints, a fixed number of training samples and a fixed total signal length per bearing: a support vector machine (SVM) using physical features, a random forest (RF) using physical features, a convolutional neural network (CNN) using raw waveforms, and a CNN using envelope

		order spectra. Sample length is defined in shaft revolutions. Experiments at multiple window scales, across rotational speeds, and with expanded coverage of training bearings comprise 680 unique final training tasks. Diagnostic performance is evaluated using macro-F1 with equal weighting across bearings and per-class recall. The results show that increasing sample length does not necessarily improve diagnostic performance. Relative model performance changes with the constraint on training data quantity and the test speed, and methods using physical features outperform the CNN using envelope order spectra under some conditions. For 10-revolution samples tested under the same operating condition as training, the SVM using physical features achieves an average macro-F1 that is 0.0116-0.0312 higher across the four data-quantity settings. Expanding the coverage of training bearings can improve overall diagnostic performance but may reduce recall for specific fault classes. With 240 training samples, the SVM's average macro-F1 under the same operating condition increases by 0.0961, whereas inner-race fault recall decreases by 0.1375. The study provides guidance on sample length and model selection for bearing fault diagnosis with limited data.
16:30-16:45	**ME044**	EVALUATING SOLAR-CONTROL WINDOW FILMS AS A BUILDING ENERGY CONSERVATION MEASURE: COOLING LOAD, ENERGY CONSUMPTION, AND COST IMPACTS USING HAP SIMULATION ***Muhammad Rehan, Mapua University, Philippines*** ABSTRACT- Buildings in hot climates experience high cooling demand, with solar heat gains through fenestration contributing significantly to HVAC electricity consumption. This study evaluates 3M Silver 15 External window film as an energy conservation measure using Carrier Hourly Analysis Program (HAP) simulation. A reference school building was adapted to Dubai, UAE, weather conditions, comparing baseline double glazing with the same glazing retrofitted with external solar-control film. Window thermal properties were determined using Berkeley Lab Optics 6 and Window 7.4 and integrated into the HAP model. Results showed a 10% reduction in annual cooling load (17,379 kWh), a 7% reduction in HVAC electricity consumption (5,171 kWh), annual savings of approximately USD 448, and a 74.1% reduction in peak-day window solar heat gains. With an estimated installation cost of USD 1,554, the retrofit achieved a simple payback period of approximately 3.5 years. The findings demonstrate that window-film retrofits are a practical and economically viable strategy for reducing cooling demand in hot climates.
16:45-17:00	**ME1001**	Voltage-Based Screening of Low-Cost Wooden Blades for Small-Scale Wind Turbines ***Minyu Liu, Yuhan Mao, Dundee International Institute, Central South University, China***

		ABSTRACT- This paper reports four prototype experiments on low-cost wooden blades. Because the experiments used different generators, fans, and measurement procedures, their voltages are compared within each program and used only as screening indicators rather than as directly comparable power measurements. The experiments examined blade shape, size, thickness, number, pitch angle, and blade-to-shaft distance. The combined evidence identifies a practical design window: a small four-blade rotor with a trapezoidal wooden blade, a nominal pitch near minus fifteen degrees, and a 1.5 cm axis offset produced the highest reported open-circuit voltage of 18.5 V within the blade-count and axis-offset study. The results also show why aerodynamic area alone is insufficient: large or numerous blades can increase wind interception while adding mass, drag, centrifugal load, and rotational inertia. This work contributes a transparent design framework for low-cost educational wind turbines by linking measurable voltage trends to aerodynamic and structural trade-offs without claiming a universal optimum.
17:00-17:15	**ME055**	Vortex generators on the edge of a photovoltaic deflector for a hybrid vertical axis wind turbine: two model CFD and piezoelectric measurements ***Bilal Al Refaie, Abu Dhabi University, United Arab Emirates*** ABSTRACT- A tilted photovoltaic (PV) panel placed below and upstream of a small hybrid Darrieus-Savonius vertical axis wind turbine can be used as a flow deflector that turns extra flow into the rotor. The flow separates at the upper edge of the deflector, however, and sends large unsteady vortices toward the blades. We tested whether fifteen vane-type vortex generators fixed along that edge reduce this unsteadiness. Unsteady Reynolds-averaged simulations at an inlet speed of 5 m/s, run with the shear stress transport k-omega model and with the transition SST model, both gave a lower volume-averaged turbulent kinetic energy around the rotor with the generators fitted, by 10.8 and 12.9 percent. In the experiment we logged nine low-cost piezoelectric vibration sensors on a bar downstream of the deflector edge, with the bar in two orientations. After correction for autocorrelation and multiple comparisons, the fluctuation level fell significantly at 4 of the 9 sensors with the bar across the flow and at 6 of the 9 with the bar along the flow, by 5 to 49 percent. All of these sensors sit behind the deflector face. The 2 reference sensors outside the face did not change, and no sensor increased significantly. Both methods agree on the direction of the effect, which has not yet been measured in rotor power.

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