CONFERENCE PROGRAM

ICEEE CETA 2026

Antalya, Turkey | April 27-29, 2026

Co-sponsored by

IEEE Turkey Section

Gazi Üniversitesi 1926

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Welcome Message

We are delighted to welcome you to the 13th International Conference on Electrical and Electronics Engineering (ICEEE 2026), which will be held in Antalya, Turkey during April 27-29, 2026. This landmark edition brings together leading researchers, engineers, industry experts, and practitioners to explore the latest advancements, challenges, and opportunities in electrical and electronics engineering, as well as their transformative applications across diverse fields.

ICEEE 2026 serves as a premier forum for sharing cutting-edge research findings, innovative technical solutions, and emerging technologies that are shaping the future of data-driven computing and intelligent systems. Over three dynamic days, the conference will feature keynote speeches, technical sessions, specialized workshops, and oral presentations covering a wide spectrum of topics, including Power Electronics, Control Systems, Signal Processing, Communication Systems, and many more frontier areas.

As a key component of ICEEE 2026, we are proud to host its affiliated workshop—the 5th International Conference on Computer Engineering, Technologies and Applications (CETA 2026), dedicated to advancing research in software and information engineering, computer theory and technology, computer science and engineering, and related interdisciplinary fields.

Our program this year includes an impressive array of keynote speeches, invited lectures, technical sessions, and interactive workshops, designed to provide valuable insights and inspire new approaches to technological innovation and education. We are honored to feature prominent speakers who will share their expertise on various critical topics, including the latest advancements in intelligent systems, innovative engineering methodologies, and the role of technology in addressing global industrial and societal challenges.

We deeply appreciate the dedication of all authors, reviewers, and participants who contribute to the intellectual vitality and success of ICEEE & CETA 2026. Your active engagement and contributions fuel progress in these critical and rapidly evolving fields. May this conference inspire meaningful discussions, foster long-term collaborations, and accelerate innovations that address pressing global challenges.

Welcome to Antalya, and enjoy ICEEE & CETA 2026!

ICEEE & CETA Organizing Committee
April, 2026

On-site Conference Information

Conference Venue

Innvista Hotel Belek

Location：Kadriye Mahallesi Beşgöz Caddesi no:8-1 Serik/Antalya, Turkey
Website: https://www.innvistahotel.com/

Reservation Team Telefone Number: +90 535 513 24 20
Hotel Telefone Number: +90 242 725 60 19
Reservation code: MAHIR2026 (please contact our hotel reservation cleark, Ms. Rüya.)

Emergency Call

✓ Comprehensive Emergency Service: **112**

Average Temperature During the Conference

12℃ - 23℃

Presentation Tips

✓ The duration of a presentation slot is 15 minutes. Please prepare your presentation for 12 minutes & 3 minutes for questions from the audience;
✓ An LCD projector & computer will be available in every session room for regular presentations;
✓ Presentations MUST be uploaded at the computer at least 15 minutes before the session starts.

Dress Code

✓ All participants are kindly requested to dress formally, as casual wear is discouraged.
✓ National formal dress is welcome.

Attention Please

✓ Please ensure the safety of your belongings in public areas. For personal and property security, delegates are advised to wear their identification badges during the conference and refrain from lending them to unauthorized individuals. The conference cannot be held responsible for the loss of personal items.

Online Conference Information

ZOOM Platform
Download Link: https://zoom.us/download

ZOOM INFORMATION Passcode: 1234		
ROOM A	https://us02web.zoom.us/j/87212811832	Zoom Test Main conference Online Session 1 Online Session 2.2 Online Session 4.2
ROOM B	https://us02web.zoom.us/j/89449330640	Online Session 2.1 Online Session 4.1 Online Session 5.2
ROOM C	https://us02web.zoom.us/j/86457622005	Online Session 3 Online Session 5.1

Time Zone

- ✓ **Turkey Standard Time, UTC/GMT +3**
- ✓ Please make sure that both the clock and the time zone on your computer are set to the correct standard time.

Sign In and Join

- ✓ Join a meeting without signing in: A Zoom account is not required if you join a meeting as a participant, but you cannot change the virtual background or edit the profile picture.
- ✓ Sign in with a Zoom account: All the functions are available.

Additional Suggestions

- ✓ A computer with an internet connection (wired connection recommended)
- ✓ USB plug-in headset with a microphone (recommended for optimal audio quality)
- ✓ Webcam (optional): built-in or USB plug-in
- ✓ Stable internet connection

- ✓ Quiet environment
- ✓ Proper lighting

Presentation Tips

- ✓ Each presentation slot is 15 minutes. Please prepare to speak for around 12 minutes, allowing 3 minutes for audience questions.
- ✓ Join the meeting room at least 10 minutes before the session begins.

Zoom Test

- ✓ Prior to the formal conference, presenter shall join the test room to make sure everything is on the right track.
- ✓ For presenters, please rename Zoom Screen Name in “Paper ID - Name” format before entering meeting room.

Conference Recording

- ✓ The entire conference will be recorded. If any participant objects to being recorded during their presentation, they are requested to inform the organizers in advance.
- ✓ The recording will be paused accordingly during their segment. Attendees are expected to dress formally and maintain appropriate decorum throughout the event.
- ✓ The recording is intended solely for conference-related purposes and academic publications. It is strictly prohibited to distribute, use commercially, or utilize the recording for any illegal activities.

Event at a Glance

April 27 Monday		April 28 Tuesday	April 29 Wednesday
10:00-17:00 Online Zoom Test		09:00-09:05 Opening Ceremony	09:30-12:05 Online Sessions 1 & 2.1 & 3
	10:00-16:00 Sign in & Materials Collection	09:05-11:55 Keynote & Invited Speeches	
		12:00-14:00 Lunch Break	12:05-13:00 Break
		14:00-16:15 Onsite Sessions 1 & 2.1 & 4.1	13:00-15:30 Online Sessions 2-2 & 4.1 & 5.1
		16:15-16:30 Coffee Break	15:30-16:00 Break
		16:30-18:30 Onsite Sessions 2.2 & 3 & 4.2	16:00-18:20 Online Sessions 4.2 & 5.2
		19:00-21:00 Dinner	

Daily Schedule – April 27, Monday

For On-site Participants

10:00-16:00	**Sign in and Collect Conference Materials** Location: **Ground Floor, Lobby of Innvista Hotel Belek** Kadriye Mahallesi Beşgöz Caddesi no:8-1 Serik/Antalya, Turkey

For Online Participants - ZOOM Test

ROOM A: https://us02web.zoom.us/j/87212811832
Passcode: 1234

** This test is designed to verify the platform's stability, check the normal operation of your audio and video equipment, and help you familiarize yourself with the platform's operations — all to avoid any technical issues that may affect your experience during the formal meeting.

10:00-13:00	**ZOOM Test for Committees / Session Chairs**
13:00-14:30 15:30-17:00	**ZOOM Test for Authors**

Daily Schedule – April 28, Tuesday

Venue: Ground Floor, Aspendos Room
Online ROOM A: https://us02web.zoom.us/j/87212811832 (Passcode: 1234)

Host: **Mahir Dursun**, Gazi University, Turkey

Opening Ceremony		
09:00-09:05	**Welcome Message** **Mahir Dursun,** Gazi University, Turkey	
Keynote Speeches		
09:05-09:45	**Keynote Speech I:** *From Smart Grids to Integrated Energy Intelligence: AI-Driven Decision Making Across Markets, Mobility, and Infrastructure* ➢ **Gokturk Poyrazoglu,** IEEE Senior Member, Ozyegin University, Turkey	
09:45-10:25	**Keynote Speech II (Online):** *Enormous Fluid Antenna System (E-FAS): Rethinking the Future of Wireless Communications* ➢ **Kai-Kit Wong,** IEEE Fellow, IET Fellow, University College London, U.K.	
10:25-10:50	Group Photo & Coffee Break	
10:50-11:30	**Keynote Speech III (Online):** *Selective Quantum Sensing via Floquet Control: From Time-Crystalline Filters to Topology-Aware Optimization* ➢ **Ozgur Mustecaplioglu,** Koç University, Turkey	
11:30-11:55	**Invited Speech:** *Artificial Intelligence Application for Condition Assessment of High Voltage Power Transformer using Health Index* ➢ **Ir. Suwarno,** Institut Teknologi Bandung, Indonesia	
11:55-14:00	Lunch | Ground Floor, INNOVA Restaurant	
Author Presentation		
14:00-16:15	**Onsite Session 1** **Power Systems, Transmission & Distribution Technologies** Session Chair: Abdullah Al-Odienat, Mutah University, Jordan B4197-A B1008 B1009 B2057 B3151 B3112 B3122 B4171 B3118	Aspendos Room Ground Floor

14:00-16:00	**Onsite Session 2.1** **Control Systems, Automation & Computing Technologies** **Session Chair:** Ali Sebetci, OSTIM Technical University, Turkey B2088 B4206 B3125 B1001 B2084 B3170 B4227 B4002	Patara Room Ground Floor
14:00-16:00	**Onsite Session 4.1** **Circuits, Signal Processing & Communication Systems** Session Chair: Bassam J. Mohd, The Hashemite University, Jordan B2075 B1005 B1006 B4191 B4194 B4216 B4187 B4220	Myra Room Ground Floor
16:00-16:30	Coffee Break	
16:30-18:45	**Onsite Session 2.2** **Control Systems, Automation & Computing Technologies** Session Chair: Rula Alrawashdeh, Mutah University, Jordan B4212 A10 A30 A40 A42 A43 B1036 A44 B1030	Aspendos Room Ground Floor
16:30-18:30	**Onsite Session 3** **Power Electronics, Electrical Machines & Drives** Session Chair: Normiza Mohamad Nor, Multimedia University, Malaysia B1017 B1015 B1022 B3127 B4188 B4200 B4224 B4226	Patara Room Ground Floor
16:30-18:30	**Onsite Session 4.2** **Circuits, Signal Processing & Communication Systems** Session Chair: Hani Muhsen, German Jordanian University, Jordan B2074 B2095 B3126 B3132 B1004 B2070 B4228 B3117	Myra Room Ground Floor
19:00-21:00	Dinner | Ground Floor, INNOVA Restaurant	

Daily Schedule – April 29, Wednesday

Online Author Presentation		
ROOM A: https://us02web.zoom.us/j/87212811832 ROOM B: https://us02web.zoom.us/j/89449330640 ROOM C: https://us02web.zoom.us/j/86457622005 Passcode: 1234		
09:30-11:35	**Online Session 1** **Power Systems, Transmission & Distribution Technologies** Session Chair: Mohamed Amine BEN AISSA, University of Sciences and Technology Houari Boumediene (USTHB), Algeria Invited Speech - Mohamad Nur Khairul Hafizi Rohani B3115 B3146 B3153 B3155 B4174 B4195 A39	Room A
09:30-12:05	**Online Session 2.1** **Control Systems, Automation & Computing Technologies** Session Chair: Mohamed Orabi, The American University in Cairo, Egypt Invited Speech - Shuang Du B1011 B2063 B2076 B3124 B3138 B4177 B2049 B3119 B4001	Room B
09:30-12:00	**Online Session 3** **Power Electronics, Electrical Machines & Drives** Session Chair: Anzar Mahmood, Mirpur University of Science and Technology, Pakistan B1034 B2064 B2066 B3105 B3157 B4203 B4207 B4208 B4199 B4202	Room C
12:05-13:00	Break Time	
13:00-15:20	**Online Session 2.2** **Control Systems, Automation & Computing Technologies** Session Chair: Diaa Fawzy, Izmir University of economics, Turkey Invited Speech - Mohammad Hafiz Mohd Yusof B3156 B4172 B2071 B4217 B1027 A27 A36 B2091	Room A

13:00-15:30	**Online Session 4.1** **Circuits, Signal Processing & Communication Systems** Session Chair: Ioana-Gabriela Sirbu, University of Craiova, Romania B3158 B1021 B3099 B3103 B3161 B4179 B2065 B2082 B2085 B3133	Room B
13:00-15:15	**Online Session 5.1** **Renewable Energy, Smart Grids & Smart Buildings** Session Chair: Mohd Fadzil Abdul Kadir, Universiti Sultan Zainal Abidin, UniSZA, Malaysia B1018 B1032 B2072 B2090 B3101 B3121 B3159 B3100 B3108	Room C
15:30-16:00	Break Time	
16:00-18:15	**Online Session 4.2** **Circuits, Signal Processing & Communication Systems** Session Chair: Canras Batunlu, Middle East Technical University Northern Cyprus Campus, Turkey B2052 B2089 B3107 B3116 B4198 B3139 B3141 B4192 B4201	Room A
16:00-18:20	**Online Session 5.2** **Renewable Energy, Smart Grids & Smart Buildings** Session Chair: Murad Al-Omary, German Jordanian University, Jordan Invited Speech - Siti Nabila Aidit B4211 A25 B3109 B4181 B3128 B4218 B4219 B1023	Room B

Keynote Speaker

Gokturk Poyrazoglu

IEEE Senior Member
Department Head, Electrical & Electronics Engineering,
Director, Grid Operations and Planning Laboratory
Ozyegin University, Turkey

Speech Time: 09:05am-09:45am, April 28
Location: Aspendos Room
Online Link: https://us02web.zoom.us/j/87212811832

Gokturk Poyrazoglu (Senior Member, IEEE) received the M.Sc. and Ph.D. degrees in electrical engineering from the State University of New York at Buffalo, Buffalo, NY, USA, in 2013 and 2015, respectively. He was with Alevo Analytics and Electric Power Research Institute (EPRI), Charlotte, NC, USA. Since 2017, he has been a Faculty Member with Ozyegin University, İstanbul, Türkiye. He is currently the Department Head of the Electrical and Electronics Engineering Department and Director of the Grid Operations and Planning Laboratory, Ozyegin University. He was the recipient of the Turkish Council of Higher Education 2022 Outstanding Achievement on University-Business World Cooperation Award.

From Smart Grids to Integrated Energy Intelligence: AI-Driven Decision Making Across Markets, Mobility, and Infrastructure

Abstract: This keynote presents a portfolio of recent research studies on AI-driven decision making for future energy systems. The talk focuses on five interconnected topics: electricity price forecasting by natural gas price signals, electric vehicle routing under dynamic prices and HVAC demand, local reactive power market design, voltage regulation in PV-rich distribution networks, and energy-, carbon-, and price-aware data center scheduling.
The central theme of the talk is the transition from conventional smart grid applications to Integrated Energy Intelligence, where power systems are operated through data-driven, optimization-based, and AI-supported decision frameworks. By combining physical grid constraints, market mechanisms, mobility behavior, renewable variability, and digital infrastructure needs, the presented studies demonstrate how future energy systems can become more flexible, sustainable, and intelligent.

Keynote Speaker

Kai-Kit Wong

IEEE Fellow, IET Fellow
University College London, U.K

Speech Time: 09:45am-10:25am, April 28
Location: Aspendos Room
Online Link: https://us02web.zoom.us/j/87212811832

Kai-Kit Wong received the BEng, the MPhil, and the PhD degrees, all in Electrical and Electronic Engineering, from Hong Kong University of Science and Technology (HKUST), Hong Kong, in 1996, 1998, and 2001, respectively. His PhD research, under the supervision of Professor Ross Murch (Primary Supervisor) and Professor Khaled Ben Letaief (Co-Supervisor), focused on the optimisation of multiuser MIMO antenna systems in the downlink. His paper in WCNC 2000 (Chicago, USA) marked the first ever research work on multiuser MIMO in the field. After graduation, he worked closely with Professor Tung-Sang Ng at the Department of Electrical and Electronic Engineering, University of Hong Kong (HKU) as a Research Assistant Professor, to continue his multiuser MIMO research. From July 2003 to December 2003, he paid a visit to the Wireless Communications Research Department of Lucent Technologies, Bell-Labs, Holmdel, NJ, U.S., to learn and collaborate with Dr. G. J. Foschini and Dr. R. Valenzuela. After that, he spent time in the Smart Antennas Research Group of Stanford University as a Visiting Assistant Professor conducting research on overloaded MIMO detection, under the supervision of Professor Arogyaswami Paulraj. His life in the UK began in December 2004 when he joined the Department of Engineering, University of Hull, to work as a Lecturer. Since August 2006, he has been with University College London (UCL), first at the Adastral Park Campus in Martlesham Heath and then from July 2009 the Department of Electronic and Electrical Engineering in Bloomsbury, where he has become Chair in Wireless Communications (i.e., Chair Professor) since October 2015.

Professor Wong is Fellow of IEEE and Fellow of IET. He is the Subject Editor-in-Chief for IET Electronics Letters - Wireless Communications. He also served as Editor-in-Chief for IEEE Wireless Communications Letters from 2020-2023, Senior Editor for IEEE Communications Letters from 2012-2019, Editor for IEEE ComSoc/KICS Journal of Communications and Networks from 2010-2017, IET Communicationsfrom 2009-2016, IEEE Transactions on Wireless Communications from 2005-2011 and IEEE Signal Processing Letters from 2009-2012.

Enormous Fluid Antenna System (E-FAS): Rethinking the Future of Wireless Communications

Keynote Speaker

Özgür E. Müstecaplıoğlu

Koç University, Turkey

Speech Time: 10:50am-11:30am, April 28
Location: Aspendos Room
Online Link: https://us02web.zoom.us/j/87212811832

Özgür E. Müstecaplıoğlu received his Ph.D. in quantum optics from Bilkent University in 1999 and subsequently carried out postdoctoral research at the Georgia Institute of Technology. He joined the faculty of Koç University in 2002 and has been a Professor of Physics since 2012, leading the Quantum Enabling System Technologies (QuEST) group. His research spans quantum optics, thermodynamics, and quantum technologies, with a focus on light–matter interactions and quantum sensing. He has held visiting appointments at ETH Zurich, Princeton University, Queen's University Belfast, and Humboldt University of Berlin. He is also an associate researcher at the TÜBİTAK Institute for Fundamental Sciences. He has authored more than 200 publications and served on the management boards of major EU quantum technology networks. His honors include the TÜBA-GEBİP Award, the TÜBİTAK Incentive Award, the METU Parlar Research Award, the Koç University Outstanding Achievement Award, and the TÜBİTAK 100th Year Science Award. He is a member of the Turkish Academy of Sciences Association and has been recognized by APS and IOP for scientific reviewing.

Selective Quantum Sensing via Floquet Control: From Time-Crystalline Filters to Topology-Aware Optimization

Abstract: This talk presents a unified perspective on quantum sensing in driven multi-qubit systems, emphasizing geometric optimization approaches, control-theoretic principles and signal-processing. We first show that periodically driven (Floquet) quantum systems can operate as tunable parameter filters, where distinct dynamical regimes, most notably period-doubling behavior associated with time-crystalline signatures, enable selective enhancement or suppression of sensitivity to competing parameters. This establishes a mechanism for targeted sensing in noisy environments, where control over dynamical phases effectively shapes the system's Fisher information landscape. Building on this dynamical viewpoint, we then consider configurational optimization of multi-qubit sensing networks, demonstrating how genetic algorithms and machine learning can identify optimal interaction topologies that maximize sensitivity under realistic constraints, revealing nontrivial scaling behavior and diminishing returns beyond optimal system sizes. Finally, we briefly introduce a complementary diagnostic framework based on topological data analysis, where persistent homology provides robust, geometry-based indicators of control degradation and noise-induced faults in driven quantum systems. Together, these results outline a coherent strategy in which Floquet engineering, network optimization, and topology-aware diagnostics form an integrated toolbox for next-generation quantum sensing and control.

Onsite Invited Speaker

Prof. Dr. Ir. Suwarno
Institut Teknologi Bandung, Indonesia

Speech Time: 11:30am-11:55am, April 28
Location: Aspendos Room
Online Link: https://us02web.zoom.us/j/87212811832

Artificial Intelligence Application for Condition Assessment of High Voltage Power Transformer using Health Index

Abstract: Power transformers are vital and costly components of the electrical power system. Ensuring the reliability and safety of these systems necessitates consistent monitoring and maintenance of transformers. The Health Index (HI) is a widely used method for assessing transformer conditions. This study models a method for calculating the transformer Health Index using artificial intelligence (machine learning) algorithms. The developed method considers transformer operating voltages and integrates dissolved gas analysis interpretations using multiple methods (Multi-methods). The findings indicate that higher operating voltages correlate with faster rates of transformer condition degradation. The non-conventional method with machine learning demonstrates higher prediction accuracy and reduces calculation subjectivity without requiring expert involvement. The Random Forest algorithm outperforms others in failure prediction based on DGA results, while Neural Networks excel in predicting HI categories with numerous input parameters. The application of the Synthetic Minority Oversampling Technique (SMOTE) improves model performance by balancing dataset classes, achieving a prediction accuracy of 99% for DGA and 97% for the Health Index.

Onsite Session 1

Power Systems, Transmission & Distribution Technologies

- **Session Chair**: Abdullah Al-Odienat, Mutah University, Jordan
- **Time**: 14:00-16:15, April 28
- **Meeting Room**: Aspendos Room, Ground Floor
- **Papers**: B4197-A B1008 B1009 B2057 B3151 B3112 B3122 B4171 B3118

B4197-A 14:00-14:15	Application of Superconducting Fault Current Limiters in Electric Aircraft DC Power Systems Authors: Bilge Şimal AMAÇ, Ahmet CANSIZ Presenter: Bilge Şimal AMAÇ, Istanbul Technical University, Turkey Abstract: In recent years, the aviation industry has shown a significant shift toward electric aircraft systems in order to improve energy efficiency, reduce fuel consumption, and minimize carbon emissions. As the electrical power demand of next-generation aircraft continues to increase, conventional aircraft power architectures are becoming insufficient, and high-voltage direct current (HVDC/DC) distribution systems are emerging as a promising alternative. However, unlike alternating current (AC) systems, direct current (DC) systems present significant challenges in fault current interruption because the current does not naturally pass through zero. Therefore, fault current management has become a critical issue in future aircraft electrical power systems. Traditional protection approaches mainly rely on circuit breakers or fuses to isolate faults. However, in high-power DC aircraft networks, fault currents can reach critical levels within milliseconds, requiring extremely fast interruption mechanisms. Under these conditions, circuit breakers alone may not provide sufficient protection. Fault Current Limiters (FCLs) offer a promising solution by limiting the fault current before protective devices operate. In this study, a DC aircraft power distribution system was modeled in MATLAB/Simulink to investigate system behavior under fault conditions. A superconducting fault current limiter (SFCL) was integrated into the proposed architecture, and its performance was evaluated in accordance with aircraft electrical power standards such as MIL-STD-704. Simulation results show that the proposed SFCL can reduce fault currents by approximately 60–70% and has the potential to improve protection in future DC aircraft power systems.
B1008 14:15-14:30	Ground Potential Rise at Various Locations from the Ground Electrodes Authors: Usman Muhammad, Normiza Mohamad Nor, Nuhu Dan-azumi Muhammad and Nurul Nadia Ahmad Presenter: Normiza Mohamad Nor, Multimedia University, Malaysia Abstract: The rise in electric potential at the ground electrode and in its vicinity would occur when the high current flows into the respective ground electrode. The ground potential rise (GPR) in general is reduced for the low fault current and ground resistance value. However, this is not straightforward enough, as the GPR may distribute unevenly in the vicinity of the ground electrode depending on the soil profiles. This is reflected by

	computational methods in some studies, however, hardly found by field measurements. This paper is therefore aimed at measuring the GPR at various locations when ground electrode is subjected to a series of impulse tests. The induced voltage that may possibly cause the rise in voltage at these locations of measurement are also being discussed in the paper.
B1009 14:30-14:45	Calibration of an Impulse Test Circuit under Various Conditions Authors: Usman Muhammad, Normiza Mohamad Nor, Fazlul Aman, Marinah Othman and Haziah Hamid Presenter: Normiza Mohamad Nor, Multimedia University, Malaysia Abstract: This paper presents and discusses the test results of an impulse test circuit used for field testing under various conditions, such as the grounding systems, resistive test loads, and the impulse generator's rating. The results ascertain that different conditions affect the test results. Although the magnitudes of voltage and current, and hence impulse impedance of a linear resistive load, are close, differences in current discharge times and the magnitude of initial oscillations on the voltage and current traces are affected by the grounding systems, resistive load, and impulse generator's rating. These variations underscore the importance of selecting appropriate testing parameters to ensure accurate and reliable results in impulse testing applications.
B2057 14:45-15:00	Grid-Forming Control Capabilities of Compressor Drive Systems for e-LNG Plant Authors: Toshiyuki Fujii, Hiroyuki Masuda, Yoshihiro Ogashi, Toshiaki Oka Presenter: Toshiyuki Fujii, Mitsubishi Electric Corporation, Japan Abstract: Grid-forming controls of the power converters are becoming attractive means to solve power grid problems such as inertia support and enhance stability of the grid. Important characteristics of the grid-forming controls are the responses to the connected grid voltage fluctuations, such as frequency, phase, and magnitude. A large-capacity liquefied natural gas plant using electrical drives often operates as a weak power system in which the grid is islanded in a remote area, and stability is important. This paper shows the evaluation results that grid-forming capabilities can be enhanced significantly when these drives employ frequency control depending on the grid frequency. Further, the transient performances have also been evaluated by simulation results for an event of tripping one of the gas turbine generators.
B3151 15:00-15:15	Topology-Dependent Protection Non-Operation in DER-Integrated Digital Substations Considering Peak and RMS Measurement Philosophy Authors: Abd Almajeed Albayaydah, Abdullah Al-Odienat, Amneh Almbaideen, Omar Alamr and Mahmood Al Hajahjeh Presenter: Abd Almajeed Albayaydah, Mutah University, Jordan Abstract: With the increasing trend of DER integration, there are new challenges for traditional overcurrent protection, especially in the context of digital substations, where the network topology is highly dynamic and flexible. The non-operation phenomenon in the context of topology-dependent overcurrent protection for digital relays has been analyzed in this study using the real-time hardware-in-loop method and RTDS simulation. For the experimental investigation, two commercial-grade digital overcurrent

	relays with different current measurement techniques, i.e., peak value and root-mean-square (RMS)/effective value, are considered. The results show that, in the context of a meshed network with multiple sources and a short-duration asymmetric fault, the instantaneous peak value currents are approximately 600 A, which are higher than the pickup value, while the RMS value currents are below the 500 A pickup value. Hence, the overcurrent relay with the RMS value current measurement principle does not operate even in the context of high-level fault conditions, while the peak value current measurement principle-based overcurrent relay operates correctly. It has also been shown in the study that the topology, i.e., the switching states of S2/S3, affects the fault currents and their values. The non-operation phenomenon in the context of overcurrent relays cannot be considered the result of the device or setting failure, as it is related to the mutual relationship between the relay principle, the characteristics of the fault transient, and the topology-dependent values of the fault currents. Overall, the study offers valuable insights into the limitations and constraints of conventional overcurrent relays in the context of DER-dominated digital substations and the importance of considering the topology and transient phenomena in the context of overcurrent protection.
B3112 15:15-15:30	Techno-Economic Modeling of Jordan's National Hydrogen Backbone: A Longitudinal Study of the Ma'an-Aqaba Water-Energy Nexus (2026–2050) Authors: Hani Muhsen, Adib Allahham and Ala'Aldeen Al-Halhouli Presenter: Hani Muhsen, German Jordanian University, Jordan Abstract: The slow implementation of green hydrogen as an alternative to blue or grey hydrogen is constrained by technical and economic feasibility. Therefore, this study presents a techno-economic model for green hydrogen production in the Ma'an-Aqaba corridor in Jordan. The research provides a novel assessment of the corridor using a high-resolution dispatch simulation that covers 8760 hours of output from a hybrid wind-solar system. The model addresses the water-energy nexus by considering a seawater transport system of 300 km. The study also used Jordan's Investment Environment Law (2022) and Gas Law (2025) to determine the study's economic parameters. The technical results of the model showed that the hybrid wind-solar system in the corridor can achieve a capacity factor of 45.2 percent. At the same time, the economic results presented a levelized cost of hydrogen of 4.20 USD per kg in 2026, projected to decrease to 1.40 USD per kg by 2050 under specific constraints. However, to maintain an internal rate of return of 18.2 percent to 14.1 percent, a 5 percent preferential tax rate is required to enhance bankability.
B3122 15:30-15:45	Technical, Economic, and Environmental Assessment of a Rooftop Solar PV System in Jordan Using Real Performance Data Authors: Yara Haddad, Ibrahim Rahoma Presenter: Yara Haddad, Al Hussein Technical University, Jordan Abstract: Based on three years of real-world operating data (2022–2024), this study presents a comprehensive performance, economic, and environmental assessment of a 51 kWp grid-connected photovoltaic (PV) system installed at Sheikh Al-Shuhada Omar Al-Mukhtar Schools in Amman, Jordan. The system's technical behavior is evaluated using standard PV performance indicators, including Final Yield (YF), Reference Yield (YR),

	Performance Ratio (PR), and Capacity Factor (CF). Economic feasibility is assessed through Net Present Value (NPV), Profitability Index (PI), Levelized Cost of Energy (LCOE), and payback period, while environmental benefits are quantified in terms of avoided CO_2 emissions. The system achieved an annual average electricity generation of 81,536 kWh, a PR of 0.73, a CF of 18.25%, and a payback period of 1.11 years. Annual CO_2 emission reductions were estimated at 55.1 tons. These results confirm that rooftop PV systems implemented in educational institutions within solar-rich regions can deliver high technical performance, strong economic returns, and substantial environmental benefits
B4171 15:45-16:00	Toward Net-Zero Energy Buildings: Optimal Energy Management Strategy for Microgrid Integrated Hydrogen-Battery Storage Syst Authors: Khaled Alzaareer, Qusay Salem, Ali Q Al-Shetwi and Claude Ziad El-Bayeh Presenter: Khaled Alzaareer, Al Hussein Technical University, Jordan Abstract: The residential system is the largest energy consumption sector in Jordan, and planning toward net-zero energy becomes a crucial matter. Energy storage units are the key solution for net-zero energy systems. However, several questions have arisen regarding energy management solutions among different types of energy systems, including Renewable Energy Resources (RESs), batteries, and hydrogen systems. This work develops an energy management strategy based on an optimization approach, aiming to minimize the total operational cost of buildings. The power produced by the fuel cell, power consumed by the electrolyzer, battery's power through charging and discharging modes, and power exchange with the grid are optimized. The optimization problem is constrained by the power capacity of energy resources and the state of charge (SOC) of energy storage elements. Numerical analyses demonstrate the correctness and efficiency of the proposed optimization-based management system.
B3118 16:00-16:15	Modified-PSO Tuned Fractional Order PID Regulator for Load Frequency Control in Interconnected Power Networks Authors: Dr Mazhar Hussain Baloch, Touqeer Ahmed, Muhammad Minhaj, Muhammad I. Masud, Mujtaba Nawaz and Muhammad Amir Raza Presenter: Mazhar Hussain Baloch, A Sharqiyah University Oman, Oman Abstract: Maintaining frequency and tie-line scheduled power changes is the prime responsibility of a load frequency control (LFC) in an interconnected system. In order to overcome the frequency deviations in an interconnected power system, an intelligent control scheme is always the most crucial task for a Control engineer. As such, this article presents a fractional order proportional integral & derivative (FOPID) controller for LFC in a two-area interconnected power network. Compared to the conventional PID, the FOPID is superior in terms of fine tuning of system parameters, however, the fine-tuning of FOPID controller is comparatively tedious task due to two additional tuning parameters (μ and). To overcome this tuning problem, the proposed controller utilizes the intelligence of A Modified Particle swarm optimization (MPSO) technique to accomplish the mentioned task with optimal dynamic response. The MPSO is a computational method that provides an optimal solution of a complex engineering problem by an

	iterative procedure. The achieved result discloses that the FOPID controller suggested by MPSO is optimized through reference model established superior dynamic response and enhanced set point tracking over other traditional controllers.

Onsite Session 2.1

Control Systems, Automation & Computing Technologies

- **Session Chair**: Ali Sebetci, OSTIM Technical University, Turkey
- **Time**: 14:00-16:00, April 28
- **Meeting Room**: Patara Room, Ground Floor
- **Papers**: B2088 B4206 B3125 B1001 B2084 B3170 B4227 B4002

B2088 14:00-14:15	Mitigating Financial Risk in Residential Rooftop PV Systems under Dynamic Tariffs: A Simulation-Based Smart Battery Management Approach Authors: Merve Demir Varici, Ahsen Ulutas, Semih Arslan and Aytekin Bucak Presenter: Merve Demir Varici, University of Wuppertal, Germany Abstract: Rooftop photovoltaic (RPV) systems play a key role in reducing carbon emissions and increasing distributed electricity generation. However, under dynamic electricity tariffs, conventional deterministic battery management strategies often fail to account for the stochastic nature of photovoltaic (PV) generation and household electricity demand, leading to increased financial risk and suboptimal economic performance. This study proposes a simulation-based smart battery management strategy that explicitly incorporates uncertainty modeling to mitigate financial risk under dynamic pricing schemes. Seasonal and intraday probability distributions are fitted to historical PV generation and consumption data, enabling a stochastic representation of supply–demand variability. Battery dispatch decisions are evaluated under dynamic tariffs with a focus on financial risk exposure rather than average cost minimization alone. A case study of a four-person household in Gelsenkirchen, Germany, demonstrates that the proposed uncertainty-aware strategy significantly enhances financial resilience. Compared to a price-blind baseline strategy, the High Price Exposure Index (HPEI) is reduced from 31.94% to 1.97%, while Battery Utilization for Cost Reduction (BUCR) increases from 48.90% to 100 %. These findings demonstrate that uncertainty-aware battery control enables robust financial protection by systematically reallocating storage usage toward high-risk price periods, rather than relying on deterministic average-based strategies.
B4206 14:15-14:30	SOC-Aware Battery Energy Management for Electric Vehicle Charging Systems Author: Ozan Gül Presenter: Ozan Gül, Bingöl University, Turkey Abstract: The increasing penetration of electric vehicles (EVs) introduces significant power fluctuations in modern power systems. These fluctuations can degrade voltage stability and power quality in EV charging infrastructures. Battery energy storage systems (BESS) are widely used to mitigate such disturbances. However, improper battery utilization may reduce battery lifetime and system reliability. In this study, a State of Charge (SOC)-aware battery energy management strategy is proposed for EV

	integrated power systems. The proposed method dynamically adjusts battery power support based on SOC levels. MATLAB simulations are conducted to evaluate system performance under different EV load conditions. Simulation results demonstrate that the proposed SOC-based control strategy significantly improves DC bus voltage stability and battery operation efficiency.
B3125 14:30-14:45	Vibration-Modulated Stress-Exposure Mapping for Multirotor UAV Batteries from Real Flight Logs Author: İrfan Alp Gürkaynak Presenter: İrfan Alp Gürkaynak, Ankara Yıldırım Beyazıt University, Turkey Abstract: A log-based stress-exposure proxy and map is presented for multirotor UAV battery post-flight review under field constraints where only pack-level telemetry is available. Maneuver intensity (gyro magnitude) and electrical loading (C-rate) are percentile-normalized and combined into a twodimensional maneuver–load envelope. A core exposure budget is accumulated to form a hotspot map (BASE). Logged vibration severity is then introduced as a tunable co-exposure amplifier, yielding an amplified accumulation (EXT) and an incremental vibration-related component (EXTRA) that highlights where high vibration coincides with maneuver–load demand. For crossmission comparability, a per-flight scaling factor is applied using an explicit conservative amplification anchor band. Tests on an open ArduPilot dataset show that exposure growth is uneven and is often dominated by short, intense episodes. These episodes are summarized through Top-K event ranking with fixed context windows. The produced outputs are stress-exposure maps for operational localization and mitigation planning, rather than direct battery degradation-rate estimates.
B1001 14:45-15:00	A Parallel Pipelined Hough Transform Algorithm for Ellipse Detection in Noisy Environment with Hierarchical Voting on AI Engines Authors: Charles Onuoha, Daniel Onwuchekwa, Roman Obermaisser, Ivor Fleck Presenter: Charles Onuoha, University of Siegen, Germany Abstract: Real-time event detection is a critical computational challenge in next-generation medical imaging, such as Compton cameras. Among the various Compton cameras under development, one type uses Cherenkov radiation from the Comptonscattered electron to determine its direction. This paper presents a complete processing pipeline on a Versal AI Engine (AIE) array that uses an optimized Ellipse Hough Transform (EHT) algorithm to detect elliptical patterns from energetic Compton electrons on a 2D Silicon Photon Multiplier (SiPM) detector array. By mapping the EHT algorithm onto the AIE's spatial, dataflow-oriented architecture, we implement a hardware pipeline achieving lower latency and higher throughput. Compared to optimized baselines on a 20-core Intel Core i7-12700K CPU (C++/OpenMP) and an NVIDIA GeForce RTX 3070 GPU (CUDA), the AIE implementation demonstrates significant architectural advantages. It achieves a mean single-image processing latency of 27.1 ms—a 100× reduction compared to the CPU and a 24× reduction compared to the GPU. These findings position the Versal AIE as a powerful platform for demanding signal processing and low-latency realtime feedback.

B2084 15:00-15:15	Determinism of Virtual PLC Traffic in Congested Converged Networks: A TSN vs Best-Effort Comparative Simulation Analysis Authors: Hüseyin Alkan, İpek Baz Presenter: Hüseyin Alkan, Siemens A.S, Istanbul, Turkey Abstract: Industry 4.0 driven converged IT/OT networks increasingly consolidate scalable virtual PLCs (vPLCs) onto shared server platforms, where real-time control loops must coexist with high-volume best-effort traffic. Under congestion, conventional best-effort Ethernet with strict-priority queuing can protect average latency but still exhibits delay variation due to non-preemptive frame transmission. This paper evaluates how TSN improves control-path determinism for multiple vPLC streams under converged background load, using a controlled A/B simulation methodology to understand behavior at scale. Two parallel simulation models share identical topology and offered load, differing only in the determinism features enabled: (i) a baseline using strict-priority queuing at congestion points, and (ii) a targeted TSN deployment adding endpoint PCP tagging, network-wide IEEE 802.1AS time synchronization, and IEEE 802.1Qbv time-aware shaping (TAS) on the congested link with a load-adapted gate schedule. Under the overload load profile ($\rho \approx 1.124$), TAS suppresses the mean uplink control jitter by 93.4% while keeping control-path delay near-constant. The results quantify the determinism improvement for industrial automation traffic and highlight the trade-off that best-effort flows may experience increased latency due to scheduled gating.
B3170 15:15-15:30	Fuzzy-Logic Based Hybrid Trajectory Control for a 2-DOF Robot Manipulator Authors: Muhammed Özdemir, M. Ergin Püsküllüoğlu, Enes Temel, Berk Atalay, Özge Nur Balta, Yücel Atalay and Zafer Bingül Presenter: Muhammed Özdemir, Berkin Engineering & Kocaeli University, Turkey Abstract: This paper presents a hybrid fuzzy-logic trajectory control scheme for a 2-DOF robotic manipulator, validated through both simulation and experimental studies. While conventional PID controllers provide satisfactory steady-state accuracy, they often fail under nonlinear dynamics and parameter uncertainties. To overcome these limitations, a fuzzy inference system is employed to adaptively tune PID gains in real time, using error and error derivative as inputs. The controller is first implemented in a custom simulation environment and subsequently deployed on a physical manipulator prototype. Comparative results demonstrate that the hybrid fuzzy-PID controller significantly reduces overshoot, decreases root-mean-square trajectory error, and achieves smoother torque profiles compared to a baseline PID controller. These findings highlight the potential of fuzzy-based hybrid control for robust and precise robotic manipulator trajectory tracking.
B4227 15:30-15:45	SCADA-Based Real-Time Fault Diagnosis and Operational State Monitoring of a Biomass Power Plant Using Machine Learning Authors: Ezgi Guney and Mahir Dursun Presenter: Ezgi Guney, Sinop University, Turkey Abstract: This paper presents a machine learning-based framework for real-

	time fault diagnosis and operational state monitoring of a biomass power plant using SCADA data. Unlike conventional monitoring approaches that rely on static thresholds or single-stage prediction models, the proposed framework integrates unsupervised anomaly detection with a domain-informed diagnostic classification layer, enabling interpretable and actionable system-level insights. A dataset comprising 15 process parameters (spanning electrical output, steam cycle conditions, grate temperatures, and flue gas quality indicators) recorded over a 24-hour operating period at one-second resolution is resampled to one-minute intervals, yielding 1,413 observations. An Isolation Forest algorithm is employed for unsupervised anomaly detection, identifying 71 anomalous minutes (5.0%). A Random Forest classifier subsequently assigns each observation to one of four operational states: Optimal, Normal, Risky, or Critical. The proposed framework achieves a classification accuracy of 95.76% and a weighted F1-score of 0.9518. Feature importance analysis identifies power output, steam pressure, and front grate temperature as the most discriminative diagnostic parameters. The results demonstrate that the framework provides actionable real-time insight for condition monitoring and early fault intervention in biomass energy systems, supporting sustainable plant operation and alignment with predictive maintenance paradigms.
B4002 15:45-16:00	CNN Based Detection of Series DC Arc Faults in Aircraft Authors: Beraat Demirel and Derya Ahmet Kocabaş Presenter: Beraat DEMIREL, Istanbul Technical University, Turkey Abstract: The transition toward the ”More Electric Aircraft” (MEA) paradigm has led to the adoption of high voltage DC (HVDC) systems such as 270 VDC and 540 VDC. HVDC systems are utilized to meet rising power demands while reducing weight. However, high-voltage architectures introduce significant safety risks, particularly series arc faults, which do not trigger traditional overcurrent protection. In vibration-prone, lowpressure aviation environments, these faults generate localized plasma exceeding several thousand degrees Celsius, potentially causing catastrophic structural damage. This paper proposes a deep learning method for the detection of such faults. Strictly grounded in MIL-STD-704F and MIL-HDBK-704-7 standards, a realistic 270 VDC bus is modeled in MATLAB/Simulink to generate a comprehensive dataset including diverse load conditions and switching transients across randomized operating points, covering both normal and arc-fault regimes. The methodology utilizes Convolutional Neural Networks (CNN) with 1 ms and 4 ms windows to capture local high-frequency irregularities and broader envelope distortions. Performance evaluations on test data generated by the Simulink model yielded high reliability. The 1 ms model delivered 99.63 percent sensitivity and more than 99.67 percent precision, whereas the 4 ms model achieved 99.92 percent sensitivity and 99.99 percent precision. These results confirm that the proposed CNN architecture accurately detects series arcs while minimizing nuisance tripping, significantly enhancing operational safety for next-generation aviation.

Onsite Session 4.1

Circuits, Signal Processing & Communication Systems

- **Session Chair**: Bassam J. Mohd, The Hashemite University, Jordan
- **Time**: 14:00- 16:00, April 28
- **Meeting Room**: Myra Room, Ground Floor
- **Papers**: B2075 B1005 B1006 B4191 B4194 B4216 B4187 B4220

B2075 14:00-14:15	CSRR-Inspired Defected Ground Plane Design for Miniaturized Patch Antenna Authors: Yiğit Parlak, Sultan Can Presenter: Yiğit Parlak, Ankara University, Turkey Abstract: In this study, a complementary split-ring resonator (CSRR) structure was applied to the ground surface of a microstrip patch antenna as a defected ground plane (DGS) to achieve possible antenna miniaturization. It was observed that a second operating band could be obtained in addition to the antenna's existing operating band, which yields dualband operation with miniaturization simultaneously. During the design process, parametric analysis was conducted to optimize the radiation processes. Regarding the results final design has been implemented on the ground plane that would allow the antenna to be miniaturized and operate in dual-band. The proposed antenna was able to operate at 2.32 GHz and 2.44 GHz, and had a gain and directivity value of 3.422 dBi and 4.791 dBi, respectively.
B1005 14:15-14:30	A Super Wideband Miniaturized THz Antenna with a Slotted Partial Ground Plane for Ultra-high Speed 6G Communication Systems Authors: Liton Chandra Paul, Sayed Shifat Ahmed, Tithi Rani, Sk. A. Shezan, Md. Ashraful Haque, Ali H Alenezi Presenter: Ali H Alenezi, Northern Border University, Saudi Arabia Abstract: In this paper, we propose a novel design for a compact and efficient THz antenna, envisioned for prospective 6G communication. The miniaturized THz antenna architecture incorporates a new-shaped patch with rectangular slots, an invertedL slots, and a slotted partial ground plane. The antenna is designed on a Rogers RT5880 material with a thickness of 10 μm and dimensions of 300×300 μm². The design achieves a wide bandwidth of 620 GHz (2.83–3.45 THz) coupled with a low reflection coefficient and high radiation efficiency, peaking at 87%. Additionally, the antenna demonstrates commendable performance in terms of VSWR, directivity, gain, and radiation patterns. The analysis of radiation material variation (gold, graphene, and copper) reveals that copper offers the best results in terms of performance and cost effectiveness. The THz antenna is well-suited for a variety of 6G applications, including high-speed wireless communication, as well as imaging, sensing, security, and material characterization within the THz frequency spectrum.

B1006 14:30-14:45	Miniaturized Triple-Wideband Double-Overlapped e-Shaped Antenna with Parasitic Elements for High-Speed THz Wireless Indoor Communications Authors: Liton Chandra Paul; Sayed Shifat Ahmed; Tithi Rani; Sk. A. Shezan; Md. Ashraful Haque; Ali H Alenezi Presenter: Ali H Alenezi, Northern Border University, Saudi Arabia Abstract: A triple-wideband miniaturized (300×300×15 μm³) double-overlapped e-shaped THz antenna with parasitic elements and a non-central slotted narrow partial ground plane is proposed for high-speed indoor THz communication applications. The antenna operates efficiently across three wide frequency bands, offering S_{11} ≤ -10 dB impedance bandwidths of 80 GHz (0.27–0.35 THz), 460 GHz (0.89–1.35 THz), and 1690 GHz (1.79–3.48 THz). Constructed using Rogers RT5880 substrate and copper conductors, the design ensures high radiation efficiency (90–92.8%), acceptable gain, good VSWR, and desirable radiation patterns. The antenna's evolutionary design process has also been thoroughly analyzed. Based on its strong performance, this antenna is well-suited for a wide range of high-speed THz indoor wireless communication systems.
B4191 14:45-15:00	Ultra-Wideband RF Energy Harvesting DGS-Fractal Antenna for Powering Indoor Wireless Sensor Nodes Authors: Elif Buse Zengin, Alperen Keser, Bilal Can Sarac, Okan Yaman, Diaa E. Fawzy, A.M.M.A. Allam, Mohamed Fathy Abo Sree Presenter: Elif Buse Zengin, Izmir University of Economics, Turkey Abstract: This paper proposes a novel compact ultrawideband patch antenna and a modified rectifier circuit for ambient RF energy harvesting for powering ultra-low-power wireless sensor networks. The design is based on the integration of a Sierpinski fractal design with the defected ground structure (DGS) technique. The optimized antenna size is 50 × 50 mm. The proposed antenna resonates from 1.72 GHz to 1.95 GHz, covering the LTE 1.8 GHz band, and from 2.12 GHz to 3.31 GHz, covering the common WiFi bands. A modified RF-to-DC rectifier with a transmission-line matching network is implemented and evaluated for input power levels ranging from 10 dBm to - 30 dBm. At a representative indoor RF level of 10 dBm, the system generates approximately 0.71 μW of harvested DC power. The validity of the proposed system is substantiated through experimental verification using a UWB localization setup experiment. The RF harvested energy is sufficient to support the deep-sleep operation of an ultra-low-power wireless sensor node.
B4194 15:00-15:15	Tunable Multi-Frequency Optical Metamaterial Absorber Based on Geometrically Scaled Double Split Ring Resonators Authors: Mazen N. Desouky, A.M.M.A. Allam, Randa M. Elkhosht, Diaa E. Fawzy and Mohamed Fathy Abo Sree Presenter: Mazen N. Desouky, German University in Cairo, Egypt Abstract: This paper presents a tunable metamaterial absorber based on a double split ring resonator (DSRR) designed to operate in the optical frequency regime. The proposed absorber achieves individually controlled resonance frequencies at 423 THz, 518THz, 640 THz, and 831 THz through systematic geometrical scaling of the resonator structure. Numerical simulations using the finite-difference time-domain (FDTD)

	method are employed to analyze the electromagnetic response of the structure. The results demonstrate strong absorption at the target frequencies with reflection minima below 20 dB. Additional resonances observed in the lower-frequency designs are attributed to higher-order surface current modes and electromagnetic coupling between the inner and outer rings. Surface current distributions reveal that the absorption mechanism is mainly governed by electric-field-driven LC resonance within the split gaps of the resonator. The proposed design provides a flexible platform for tunable optical absorbers with potential applications in sensing, filtering, and photonic devices.
B4216 15:15-15:30	A Complementary Split Rings Patch Antenna for Ice Detection Author: Rula Alrawashdeh Presenter: Rula Alrawashdeh, Mutah University, Jordan Abstract: In this paper, a rectangular patch antenna with complementary split rings (CSRs) for ice detection is designed and proposed. The CSRs are integrated to the antenna structure to fine tune its resonance and to provide an area of coupling with the material under test. The antenna was able to detect ice with a notable frequency shift of 56 MHz for a thickness of 1 mm. The antenna obtained a gain value 0.32 dBi without loading and -0.33 dBi when loaded with a layer of 3mm thickness. The frequency shift was almost negligible when the thickness increases above the 3 mm thickness level. However, the frequency shift obtained for thin layers was reliable enough for early notification purposes while the saturated shifting level was also good for the purposes of monitoring ice accumulation. The proposed work presents a promising candidate for a sensor antenna. Additionally, it contributes new results regarding the use of CSRs in sensing antenna applications.
B4187 15:30-15:45	Cost, Weight, and Dimensional Evaluation of Dry-Type Distribution Transformers: A Comparative Study Based on TEDAŞ Standards Authors: Kamran Dawood, Furkan Gezer, Semih Tursun Presenter: Kamran Dawood, Astor Enerji, Turkey Abstract: Transformers are the pivotal components of contemporary electrical distribution systems. Their design directly influences installation ease, purchase cost, and long-term operational expenses. In rapidly evolving power networks, selecting the optimal transformer configuration is crucial for maximizing cost efficiency and spatial utilization. This study provides a thorough comparative analysis of three dry-type distribution transformers rated at 400 kVA, 800 kVA, and 1600 kVA, designed in accordance with TEDAŞ specifications. The research examines the physical dimensions, overall weight, and financial expenditure associated with the transformers. This highlights the influence of transformer configuration on overall costs. Key findings show that a single 1600 kVA unit, compared to four 400 kVA transformers with the same total capacity, requires only one installation space and can significantly reduce material and labor costs while occupying approximately 60% less floor area than the equivalent multiple-unit configuration. However, smaller units possess certain advantages, including redundancy, modular deployment, and the capacity to occupy confined spaces. This is particularly advantageous in urban areas where space is constrained and dependability is paramount.

	The findings provide transformer engineers and power companies with valuable guidance on balancing capital investment, operational flexibility, and spatial constraints. This study compares transformer configurations based on TEDAŞ standards, providing a structured evaluation of their cost, dimensional, and weight characteristics in relation to practical installation considerations.
B4220 15:45-16:00	Electrical Impact of Winding Material Selection on Transformer Design: A Comparison of TEDAŞ and Tier 2 Specifications Authors: Kamran Dawood, Muhammed Alperen Çakir, Semih Tursun Presenter: Kamran Dawood, Astor Enerji, Turkey Abstract: The electrical performance of transformers is strongly influenced by the choice of winding material and compliance with applicable regulatory standards and specifications. This study compares aluminum wound and copper wound dry-type transformers designed in accordance with the Turkish TEDAŞ specification and the European Tier 2 specification. Key electrical parameters, including number of turns, magnetic flux density, no-load losses, load losses, and leakage impedance, are analyzed for a 2000 kVA, 33/0.4 kV distribution transformer. The results show that copper's lower resistivity leads to reduced load losses, whereas aluminum requires larger conductor cross-sections to achieve comparable efficiency. The Tier 2 specification imposes stricter thresholds on both no-load and load losses, resulting in designs with lower flux densities and improved loss performance compared to TEDAŞ. These findings provide practical insights for transformer designers seeking to balance winding material selection with compliance across diverse regulatory contexts.

Onsite Session 2.2

Control Systems, Automation & Computing Technologies

- **Session Chair**: Rula Alrawashdeh, Mutah University, Jordan
- **Time**: 16:30-18:45, April 28
- **Meeting Room**: Aspendos Room, Ground Floor
- **Papers**: B4212 A10 A30 A40 A42 A43 B1036 A44 B1030

B4212 16:30-16:45	Age Matters: Evaluating Cross Population Generalization in Wearable Sensor Based Human Activity Recognition Authors: Muhammad Owais Raza, Anmol Babar, Harun Elkiran, and Jawad Raheed Presenter: Muhammad Owais Raza, Istanbul Sabahattin Zaim University, Turkey Abstract: Human Activity Recognition (HAR) using wearable sensors has become an important component of many healthcare and assistive technologies. Most HAR models are trained on datasets collected from a specific age group (Adults, children, elderly people, etc.), which limits the ability of the HAR system to generalize across diverse populations. In this study, we investigate the impact of age differences on HAR model performance. We are using two publicly available accelerometer datasets representing younger adults and older adults. Firstly, we extracted rolling window statistics, and intensity feature Signal Magnitude Vector (SMV) from raw sensor data, then we analyzed movement patterns across both groups using the SMV. We also trained and evaluated 5 Machine learning models, namely Random Forest, Decision Tree, Multilayer Perceptron, and Gradient Boosting, on the same and cross-dataset configurations. We also trained deep learning algorithms namely: 1 Dimensional Convolutional Neural Network (1D-CNN) and Long Short-Term Memory (LSTM). Based on results, models trained and evaluated on the same population achieve high performance, with Random Forest reaching accuracies of 92.2% and 92.8% for the older and younger datasets, respectively. However, when models trained on one population are evaluated on the other, performance drops significantly. Results improved when the model was trained and tested on a combined dataset with age-awareness, achieving an accuracy of 91.8%. We also performed the feature abalation study and feature extracted from the raw sensor data can improve the model performance over only raw sensor data. These results show the importance of age-aware modeling in HAR systems.
A10 16:45-17:00	A DBMS-Independent Proxy Architecture for Secure Database Query Interception and Audit Logging Authors: Ali Osman Kabil, Erdem Çer, Sefa Sarı, Mustafa E. Kamaşak Presenter: Ali Osman Kabil, Yurtiçi Kargo R&D Center, Turkey Abstract: Managing user access across heterogeneous database systems poses significant challenges, particularly when security policies must be applied consistently in environments with varying query structures and

	communication protocols. These challenges often lead to fragmented control mechanisms and increased exposure to insider threats. This study presents a DBMS-independent, proxy-based database security architecture positioned between clients and database servers to enable centralized query interception and policy enforcement. The proposed system operates at the network layer, reconstructing and analyzing SQL queries in real time based on predefined security profiles. Unauthorized queries are either blocked or returned in a masked format to prevent sensitive data exposure. In addition, all client–database interactions are comprehensively logged, establishing an audit-ready dataset that supports future behavioral analysis and anomaly detection studies. Experimental results based on comparative latency measurements demonstrate that the proposed proxy architecture introduces no statistically significant performance overhead. Rather than focusing on detection algorithms, the contribution of this work lies in delivering a robust, DBMS-agnostic security enforcement layer that enables consistent access control, comprehensive auditing, and behavioral analysis readiness in heterogeneous enterprise environments.
A30 17:00-17:15	Comprehensive Comparison of Machine Learning Methods for Remaining Useful Life Prediction of Turbofan Engines: An Experimental Analysis on All C-MAPSS Subsets Authors: Hasan CANBAZ, Shahaboddin DANESHVAR Presenter: HASAN CANBAZ, Hasan Kalyoncu University, Turkey Abstract: Remaining Useful Life (RUL) prediction of turbofan engines is critical for predictive maintenance and flight safety. Although numerous studies have addressed this problem using machine learning methods, most focus on a single subset of NASA's C-MAPSS dataset (typically FD001) and employ a limited number of models. This paper presents a comprehensive comparative analysis of eight machine learning regression methods across all four C-MAPSS subsets (FD001–FD004), spanning single and multiple operating conditions as well as single and multiple fault modes. The methods evaluated include Linear Regression, Decision Tree, Random Forest, Gradient Boosting, Support Vector Regression (SVR), Multilayer Perceptron (MLP), XGBoost, and LightGBM. Using 10-fold cross-validation and independent test sets, model performance is assessed through multiple correlation coefficient (R), root mean square error (RMSE), mean absolute error (MAE), and coefficient of determination (R^2). Results demonstrate that ensemble methods, particularly LightGBM and Random Forest, consistently achieve the lowest RMSE values across all subsets. LightGBM attains the best performance on FD001 (R = 0.9120, RMSE = 16.92), while Random Forest achieves the best results on FD002 (R = 0.9172, RMSE = 17.14) and FD004 (R = 0.8924, RMSE = 19.56). Dataset complexity significantly impacts all models, with RMSE increasing by up to 55% from the simplest (FD001) to the most complex subset (FD004). The findings provide practical guidelines for selecting appropriate regression methods under varying operating conditions.
A40 17:15-17:30	A Multimodal Speech and Text-Based AI Clinical Decision Support System for Post-Traumatic Stress Disorder Risk Assessment Authors: Saadin Oyucu, Hayriye Mihrimah Ozturk, Huseyin Polat, Muhammed Emin Korkut

	Presenter: Saadin OYUCU, Gazi University, Turkey Abstract: After earthquakes, war, forced migration, and similar large-scale traumatic events, individuals may develop a psychiatric disorder known as Post-Traumatic Stress Disorder (PTSD). This psychiatric disorder can lead to long-lasting and serious effects. Early detection of PTSD is crucial for effective and appropriate treatment. Currently, the assessment process used for diagnosing PTSD requires clinical interviews conducted by a psychiatrist. Diagnosis is made by clinicians through clinical evaluation and the use of standardized scales such as the Clinician-Administered PTSD Scale for DSM-5 (CAPS-5), which is based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). However, this process, relying on clinical assessment and standardized scale-based evaluations, is time-consuming, requires specialized expertise, and may be limited by accessibility issues. This study proposes a support system named “SesMind Clinic” for PTSD risk assessment. The proposed system is an AI-assisted clinical decision support system operating on a fully local infrastructure. It uses an Automatic Speech Recognition (ASR) module optimized for Turkish. Furthermore, a Bidirectional Encoder Representations from Transformers (BERT) model is used for text classification, while Google Health Acoustic Representations (HeAR) and a Multilayer Perceptron (MLP) are employed to extract and analyze acoustic patterns. The system is designed as an integrated architecture that also includes a Large Language Model (LLM)-based dialogue management layer. Accordingly, both the semantic content of the individual’s speech and its prosodic and spectral features are analyzed simultaneously. The study provides clinicians with an interpretable assessment of PTSD risk at three levels: low, moderate, and high. The evaluation was conducted with a total of 311 participants, including 154 PTSD patients and 157 healthy controls, following the February 6, 2023, Kahramanmaraş earthquakes. The results show that the Word Error Rate (WER) of the ASR module decreased from 22.43% to 16.99%. In the BERT-based classification task, an accuracy of 91.49% and an F1-score of 91.49% were achieved. In the acoustic analysis module, an accuracy of 98.26% was obtained. Overall, the findings demonstrate that an AI-supported, explainable, and secure clinical system has been developed for the multidimensional early detection of PTSD risk. This study presents a promising solution that can effectively support expert-driven clinical decision-making.
A42 17:30-17:45	A Deep Learning Model for Anomaly Detection in Video Using Object Segmentation and Localization Authors: Ahmet Galip Şengün, Onur Ilgaz, Aylin Yorulmaz, M. Ali Akcayol Presenter: Ahmet Galip Şengün, İNOSENS Bilişim Teknolojileri San. ve Tic. Ltd. Şti., Turkey Abstract: Video anomaly detection is an important problem for intelligent surveillance, public safety, and smart environment monitoring. Traditional approaches often focus on classification, thereby failing to detect anomalous events in real time. This paper proposes a novel multimodal anomaly-detection model that integrates text-based anomaly interpretation, named entity recognition (NER), open-world object

	detection, segmentation, and depth-aware localization. The proposed system combines a vision-based anomaly description model, NER-based keyword extraction, the segment anything model (SAM) for segmentation, and Video Depth Anything for monocular depth estimation. Sensor-based depth measurements from Intel RealSense cameras are used in the experiments. Experiments on real-world videos show that the proposed pipeline provides semantically grounded and spatially localized anomaly analysis, enabling both pixel-level and object-level reasoning.
A43 17:45-18:00	Automatic Topic Modeling Using Optimized BERTopic Authors: Hilal Genç, Onur Ilgaz, Aylin Yorulmaz, M. Ali Akcayol Presenter: Hilal Genc, İnosens Information Technologies Abstract: Topic modeling aims to discover latent semantic themes in large collections of documents. Although Latent Dirichlet Allocation (LDA) has long been a standard approach, recent transformer-based methods such as BERTopic use contextual embeddings and class-based TF-IDF to improve topic interpretability. This paper presents an automatic topic-modeling system based on a modified BERTopic pipeline. The proposed pipeline was applied to an airport customer- complaints dataset that includes passenger reviews. The dataset was synthetically created using AI tools to simulate realistic passenger feedback across stakeholder services, operational quality indicators, and passenger types. The proposed pipeline integrates multilingual sentence embeddings, Uniform Manifold Approximation and Projection (UMAP) for dimensionality reduction, Hierarchical Density-Based Spatial Clustering of Applications with Noise (HDBSCAN) for clustering, and class-based TF-IDF (cTF-IDF) for topic representation.
B1036 18:00-18:15	Quantifying Carbon Emissions of Machine Learning Inference Models Running on Edge IoT Devices Authors: Aqsa Bano Kaim Khani, Sam Amiri, and Luciano Ost. Presenter: Aqsa Bano Kaim Khani, Wolfson School MEME Loughborough University Loughborough, U.K Abstract: Energy efficiency and carbon-footprint reduction have become critical design priorities in edge-based machine learning deployments. This research quantifies the carbon footprint of ML inference models in both FP32 and INT8 quantization formats running on different Arm Cortex processors. Results indicate that the use of quantization can have a significant reduce the carbon footprint while keeping object detection accuracy. For instance, based on the projected number of autonomous vehicles in the USA by 2030, applying quantization to objectdetection models would yield a carbon-footprint reduction of 178,485 tonnes, which is equivalent to eliminating nearly 130 daily transcontinental flights (e.g., New York to San Francisco). This work sets quantitative sustainability benchmarks, showing that model quantization is crucial to obtain carbon efficiency in edge ML computing devices.
A44 18:15-18:30	A44 A Greedy Multi-Metric Heuristic for Energy-aware Dynamic Load Balancing in Cloud Environments Authors: Mohammed Al-Jarrah, Ali Yousefi, Ali Salman, Dania Hani Abu Daqar, Mohamad Awad

	Presenter: Mohamad Awad, Kuwait University, Kuwait Abstract: Dynamic load balancing is a critical component of cloud computing infrastructures, aiming to optimize resource utilization, reduce task response time, and maintain system performance under fluctuating workloads. Unlike static approaches, dynamic methods adapt in real-time to changing conditions, enabling more efficient task allocation and energy usage. This paper proposes a novel greedy heuristic that incorporates a scalarized multi-metric objective function to balance throughput, energy efficiency, and load distribution across virtual machines. The proposed algorithm is implemented and evaluated using CloudSimPlus, and its performance is benchmarked against standard baseline strategies, including Round Robin, Random Allocation, and Least Loaded. Experimental results demonstrate that the proposed method achieves significant power savings while maintaining comparable performance in terms of makespan and throughput. These findings suggest its effectiveness as a potential solution for a scalable and energy-aware dynamic scheduling strategy for modern cloud data centers.
B1030 18:30-18:45	A Novel Power-Angle–Based Protection Scheme for Symmetrical Fault Discrimination Under Load Encroachment in Smart Grids Authors: Hamidreza Eshrati, Tohid Ghanizadeh Bolandi and Behrouz Tousi Presenter: Tohid Ghanizadeh, BolandiUrmia University, Iran Abstract: Reliable discrimination between internal symmetrical faults from load encroachment (LE) is essential in modern power networks, particularly when distributed generation is integrated within the protected zone. Incorrect fault identification can lead to unnecessary tripping of generation units, prolonged instability, or even large-scale outages. This paper introduces a new protection method based on the phase angle of complex power measured at both ends of the protected line. The proposed index is defined as the difference between the complex power angles calculated at the sending and receiving terminals. A detailed network model comprising a main generator, a downstream distributed generation unit, a transformer, transmission lines represented by the π-model, and a balanced three-phase load is developed. Various symmetrical faults are simulated at several locations inside and outside the protection zone. Simulation results show that internal symmetrical faults consistently produce a large and stable angle difference, whereas external faults/LE yield smaller or oscillatory angle responses. A heavy-load scenario is also examined to ensure that load increases are not misclassified as internal faults. The proposed approach relies solely on phasor measurements and simple calculations, making it compatible with existing protection hardware and offering a practical solution for smart grids with integrated distributed generation.

Onsite Session 3

Power Electronics, Electrical Machines & Drives

- **Session Chair**: Normiza Mohamad Nor, Multimedia University, Malaysia
- **Time**: 16:30-18:30, April 28
- **Meeting Room**: Patara Room, Ground Floor
- **Papers**: B1017 B1015 B1022 B3127 B4188 B4200 B4224 B4226

B1017 16:30-16:45	Feature Selection Analysis of Remote Sensing and Climate Features for Potential Fishing Zones (PFZ) Classification Using Machine Learning Authors: Nik Nur Shaadah Nik Dzulkefli, Norsuzila Ya'acob, Mohd Azri Abdul Aziz, Azita Laily Yusof and Roslan Umar Presenter: Nik Nur Shaadah Nik Dzulkefli, Universiti Teknologi MARA, Malaysia Abstract: This study focuses on identifying the most significant environmental factors for predicting Potential Fishing Zones (PFZ) using satellite-derived oceanographic and climate data. The dataset contains sea surface temperature (SST), night sea surface temperature (NSST), chlorophyll-a (Chl-a), diffuse attenuation coefficient (KD490), normalized fluorescence line height (nFLH), rainfall, and wind speed. A multi-method feature selection framework was implemented and validated using Leave-One-Feature-Out (LOFO), Leave-One-Feature-Out Cross-Validation (LOFO-CV), permutation importance, and Leave-One-Feature-Out Recursive Feature Elimination (LOFO-RFE).The results consistently show that six features of SST, NSST, Chl-a, KD490, nFLH, and rainfall are the most important for classifying PFZ. A Random Forest classifier trained on the verified six-feature subset achieved similar accuracy to the full feature set, indicating that model complexity can be reduced without decreasing predictive accuracy. The proposed structure offers an efficient method for identifying features that affects PFZ classification and supports the sustainability of fisheries prediction systems.
B1015 16:45-17:00	Robustness Assessment of Boost Converters Under Parametric Uncertainties Using Sobol's Sensitivity Analysis and Monte Carlo Simulations Authors: Siti Khadijah Hasan, Nuraiza Ismail, Ermeey Abd Kadir Presenter: Nuraiza Ismail, Universiti Teknologi MARA, Malaysia Abstract: Boost converters serve as essential components in modern power electronics, particularly within renewable energy systems and electric vehicles. This study focuses on enhancing their robustness against parametric uncertainties, including component tolerances, environmental influences, and load variations. By employing Sobol's sensitivity analysis and Monte Carlo simulations, the steady-state performance of boost converters is systematically evaluated under diverse operating conditions. A MATLAB/Simulink model coupled with Python's SALib library enables detailed examination of parameter uncertainties in resistors, inductors, and capacitors. Through the analysis of output voltage deviations, valuable

	insights into converter sensitivity and performance stability are obtained. The investigation identifies key parameters influencing robustness and introduces a quantitative robustness index derived from statistical measures such as mean, standard deviation, and error rates. Findings confirm that the proposed approach effectively enhances boost converter designs to endure real-world uncertainties while sustaining efficient performance. Overall, this integrated uncertainty analysis contributes to the advancement of reliable and resilient power conversion technologies for a wide range of applications.
B1022 17:00-17:15	Development of a Magnetic Gear-Based Regenerative Braking System for Lightweight Electric Vehicles Authors: Kerem ABAŞLIOĞLU, Mehmet GÖL, Uğur DEMİR, Necibe Füsun OYMAN SERTELLER Presenter: Kerem ABAŞLIOĞLU, Marmara University, Turkey Abstract: Magnetic gears and flywheel energy storage systems have recently gained attention as promising solutions for improving the efficiency of lightweight electric vehicles. Unlike conventional mechanical gears, magnetic gears provide contactless torque transmission with reduced noise, wear, and maintenance requirements. In this study, a magnetic-gear-assisted flywheel concept is proposed to enhance regenerative braking performance and support energy reuse during acceleration.A simplified vehicle model is developed to estimate the braking energy available under different driving conditions. Using regenerative power profiles extracted from standard cycles— HWFET, UDDS, NEDC, and Artemis Motorway (ArtMw150)—a preliminary flywheel design is performed to determine feasible geometric and material parameters for short-term kinetic energy storage. The magnetic gear is positioned between the motor and flywheel to ensure smooth and frictionless energy transfer. Simulation results show that the system can recover 6.589 kJ of braking energy in HWFET, 19.34 kJ in UDDS, 7.144 kJ in NEDC, and 10.61 kJ in ArtMw150, corresponding to a potential 11.11% improvement in regenerative braking efficiency. These findings demonstrate that the proposed magnetic gear–flywheel structure can support meaningful energy recovery in realistic driving conditions, offering a compact and low-maintenance solution for next-generation micro-mobility platforms.
B3127 17:15-17:30	Robust DC-Link Voltage Regulation and THD Reduction in Two-Stage PV Systems Using Artificial Neural Networks Authors: Adel Bouledroua, Tarek Mesbah, Samia Kelaiaia Presenter: Adel Bouledroua, Badji Mokhtar University, Algeria Abstract: The dynamic performance of the DC-DC boost converter is critical for maximising energy extraction and ensuring power quality in grid-connected photovoltaic (PV) systems. However, conventional control schemes, typically combining Perturb and Observe (P&O) MPPT with Proportional-Integral (PI) voltage controllers, often exhibit steady-state oscillations and slow transient responses under varying irradiance conditions. As a result, these limitations destabilise the DC-link voltage and increase the Total Harmonic Distortion (THD) of the grid-injected current. To address these issues, this paper proposes an intelligent dual control strategy using artificial neural networks (ANNs) for both maximum point

	tracking (MPPT) and DC-Link voltage regulation. In this context, the proposed ANN, trained with LevenbergMarquardt, replaces the linear PI control loop for efficient handling of nonlinearity in the system. According to MATLAB/Simulink simulation results, the ANN-based strategy eliminates steady-state oscillations and significantly improves transient tracking. It is noteworthy that the proposed method reduces the current grid THD from 4.17% (conventional P&OPI) to 2.81% (low-level THD) while maintaining under standard test condition STC of 1.43% (lower-level of THD). The findings confirm the system's exceptional robustness and adherence to IEEE 519 grid standards.
B4188 17:30-17:45	Analytical Model and Experimental Test System Design of a Permanent Magnet Synchronous Hub Motor for a Solar Vehicle Authors: Kübra Tural, Aytaç Gören, Aybüke Yurtsever, Elif Yağmur Dağ, Hasan Uysal Presenter: Kübra TURAL, Dokuz Eylül üniversitesi, Turkey Abstract: In recent years, the adverse effects of global warming and climate change have become increasingly evident. The transportation area is one of the contributors to these negative impacts. To mitigate such effects, there has been a growing shift toward the use of clean energy sources, a trend that is also reflected in the transportation area. Within this context, the use of electric energy, considered a clean energy source among internal combustion engine vehicles, has become widespread in vehicles. Electric motors are one of the key components that influence the overall energy consumption of electric vehicles. Therefore, the characteristics, structure, and efficiency of electric motors used in electric vehicles are crucial. Although the nominal properties of manufactured electric motors are well defined, these characteristics may vary over time due to operational and environmental factors. In this study, the mathematical model of an in-wheel electric motor designed for a solar-powered vehicle was experimentally validated using a specially developed test bench.
B4200 17:45-18:00	Design and Implementation of a CLLC Resonant Converter for On-Board Charger Applications in Electric Vehicles Authors: Emre Can Yildiz, Bunyamin Tamyurek Presenter: Emre Can Yildiz, Gazi University, Turkey Abstract: This paper presents the analysis, design, and closed loop control of a CLLC resonant converter for the isolated DC–DC stage of an electric vehicle (EV) on-board charger (OBC). The CLLC topology is well-suited for OBC applications due to its high efficiency, soft-switching capability, and wide voltage regulation range required for battery charging. The operating principles of the converter are explained, and a steady-state analysis based on the First Harmonic Approximation (FHA) method is carried out to derive the voltage gain characteristics and evaluate the effect of resonant tank parameters. A closed-loop control strategy based on Pulse Frequency Modulation (PFM) is implemented to regulate the output current under varying load conditions. The proposed design and control approach are validated through experimental results.
B4224 18:00-18:15	IoT-Based Mobile Interface and Real-Time Parameter Estimation in Smart Battery Management Systems Authors: Eşref Kutay Gökduman, Ali Durmuş, Ahmet Aksöz and Mahir

	Dursun Presenter: Ahmet Aksöz, Kayseri University, Türkiye Abstract: Advances in energy storage technologies have led to lithium-ion and LiFePO4 batteries becoming the industry standard. However, the risk of thermal runaway and the aging processes of these batteries necessitate the use of advanced Battery Management Systems (BMS). While traditional BMS architectures typically operate in a closed-loop system, this study designed a smart BMS based on the Internet of Things (IoT) that can perform real-time data estimation and provides cloud synchronization via a mobile interface. The developed system was tested on a 100Ah LiFePO4 battery pack configured in a 16S arrangement. Using ESP32 at the hardware layer, telemetry data such as voltage, current, and temperature are collected to calculate State of Charge (SOC) and State of Health (SOH) parameters, which cannot be measured directly. The collected data is visualized through a multi-page mobile application (QTWAY BMS) developed on an infrastructure supported by FastAPI and PostgreSQL; passive cell balancing, historical data analysis, and a user-defined autonomous alert infrastructure have been successfully validated. The proposed system enables predictive maintenance in industrial settings by transparently monitoring battery health.
B4226 18:15-18:30	Prototype Implementation and Adaptive PID-Based Precision Position Control of a High-Torque Density Limited Angle Torque Motor Authors: Akin Aydin and Ali Saygın Presenter: Ali Saygın, Gazi University, Türkiye Abstract: Simulation-based motor designs have become a widely adopted approach due to their flexibility, efficient comparison of results, and the ability to quickly observe outcomes. However, the reliability of such designs is largely dependent on experimental validation and environmental conditions. In this study, a previously optimized four-pole limited-angle torque motor design was extended through prototype production, and comprehensive experimental tests were conducted using adaptive PID-based position control to evaluate real-world performance. During prototype motor production, mechanical tolerances, air gap variations, and constraints on the symmetrical structure of the toroidal winding were taken into account. To achieve high-precision angular positioning, an adaptive PID control strategy was implemented, where controller gains were adjusted according to the rotor angle and rotation direction using a predefined gain search table. Experimental results demonstrated positioning accuracy lower than 0.1° across the entire operating range, significantly improving upon traditional fixed-gain PID control. The proposed control approach effectively compensates for the nonlinear torque characteristics, friction, and direction-dependent disturbances specific to limited-angle torque motors. The findings provide valuable insights into transitions from simulation to prototype and highlight critical factors that should be incorporated into future engine design and modeling processes to improve prediction accuracy.

Onsite Session 4.2

Signal Processing & Computing Architectures for Communication & Sensing

- **Session Chair**: Hani Muhsen, German Jordanian University, Jordan
- **Time**: 16:30-18:30, April 28
- **Meeting Room**: Myra Room, Ground Floor
- **Papers**: B2074 B2095 B3126 B3132 B1004 B2070 B4228 B3117

B2074 16:30-16:45	EdgeEvoFilter: Energy–Quality-AwareReconfigurable Approximate Gaussian Filtering for Edge AI Authors: Sawera Sana, Sajid Gul Khawaja, Asad Mansoor Khan, Muhammad Usman Akram, Arslan Shaukat Presenter: Sawaira Sana, National University of Sciences and Technology (NUST), Pakistan Abstract: Edge AI devices increasingly execute computationally intensive filtering tasks, from sensor fusion to medical imaging, under strict energy and latency constraints. Gaussian filtering is widely used for noise suppression and feature enhancement, yet its high computational and energy cost limits deployment on resource-constrained platforms. We present EdgeEvoFilter, a reconfigurable approximate Gaussian filtering framework that jointly optimizes approximate adders and multipliers from the EvoApprox8b library using evolutionary design space exploration. Evaluated on ultrasound imaging, the framework generalizes to diverse edge AI workloads. Across 20 ultrasound images, EdgeEvoFilter evolved designs achieving up to 71% power reduction, 66% area reduction, and PSNR exceeding 39 dB with SSIM ≈ 0.99. While these best values arise from different evolved designs, the QUAP-optimal configuration achieved the best overall trade-off (score = 349), highlighting the strength of Pareto-optimized approximation. Crucially, this flexibility allows practitioners to select designs tailored to application needs for example, power- or area-optimized variants for IoT devices, and quality-preserving variants for medical imaging. Comparative evaluation of three optimizers—NSGA-II, NSGAIII, and MOPSO within the EdgeEvoFilter framework confirms that NSGA-II delivers the most effective Pareto-optimal tradeoffs.
B2095 16:45-17:00	Feasibility of nuclear radiation detection using the SRAMs in AMD Spartan UltraScale+ FPGAs Authors: Andrei Bertescu, Stefan Popa, Radu-Mihai Coliban Presenter: Stefan Popa, Transilvania University of Brasov, Romania Abstract: In this paper we explore the feasibility of employing the soon-to-be-released, cost-optimized and power-efficient AMD Spartan UltraScale+ Field Programmable Gate Array (FPGA) devices to dynamically sense the nuclear radiation flux in irradiated environments, such as those of high-energy physics experiments. The flux is determined based on the Single Event Upsets (SEUs) detected in five different types of memory resources,

	including the Look-Up Tables (LUTs) and the new high-capacity and density, generation-specific UltraRAM blocks. Even though the device family is not fully released, we estimate the power draw and cross-section and compare the results with those of other FPGA devices.
B3126 17:00-17:15	Comparative Performance Analysis of Direction Finding Techniques with PCA and Variant Algorithms Authors: Mehmet Zahid ERGİN, Özgür ERTUĞ Presenter: Mehmet Zahid ERGİN, ASELSAN Elektronik Sanayi ve Ticaret Anonim Sirketi, Turkey Abstract: This paper investigates the application of Principal Component Analysis (PCA) and its variants to Direction-ofArrival (DOA) estimation in signal processing. The core objectives are threefold: to explore how PCA principles can be leveraged for direction-finding, to comparatively evaluate the performance of different PCA variants under challenging conditions (high noise, multiple sources), and to propose a novel optimized PCA-based algorithm. Simulation experiments conducted in MATLAB benchmark the PCA variants against each other in terms of estimation accuracy, computational complexity, processing speed, and noise robustness. The study also positions these methods against conventional DOA techniques — namely MUSIC and ESPRIT — analyzing the trade-offs in performance, flexibility, and hardware requirements. DOA estimation is a foundational capability across radar systems, autonomous vehicles, acoustic localization, and wireless communications. While classical methods like MUSIC and ESPRIT deliver strong performance, they are computationally intensive and sensitive to array geometry. PCA-based approaches, by contrast, are more amenable to low-cost hardware and support flexible array configurations. By systematically evaluating performance across varying noise levels, source counts, and antenna geometries, this work ultimately aims to develop a PCAbased DOA estimation algorithm suitable for deployment in realtime, resource-constrained systems.
B3132 17:15-17:30	A Comparative Analysis of Greedy Sparse Signal Recovery Algorithms for Direction Finding in Electronic Support Measurement Systems Authors: İlhan ERAY, Özgür ERTUĞ Presenter: İlhan ERAY, ASELSAN Elektronik Sanayi ve Ticaret Anonim Sirketi, Turkey Abstract: Direction finding (DF) operations are critical for modern Electronic Support (ES) systems, particularly within complex electromagnetic environments characterized by multiple threats and low signal-to-noise ratios (SNR). This study leverages the spatial sparsity of signal sources to investigate the contributions of sparse estimation algorithms, rooted in compressed sensing principles, to DF performance in ES architectures. In this context, alongside the classical Orthogonal Matching Pursuit (OMP) algorithm, we integrated the Perturbed OMP (POMP)—designed for robustness against model uncertainties and off-grid issues—and the Generalized OMP (gOMP), aimed at optimizing computational overhead, into the ES system framework. The effectiveness of these proposed approaches is numerically validated through comprehensive Monte Carlo simulations using Gaussian-based antenna gain models and various circular antenna array configurations. Our findings demonstrate that the Perturbed

	OMP algorithm provides a more stable performance by significantly reducing Root Mean Square Error (RMSE) values compared to the classical OMP, especially in detecting off-grid targets and operating at low SNR levels. Conversely, the gOMP algorithm was found to reduce processing time by over 75% while maintaining direction-finding precision in multi-threat scenarios. These results confirm that sparse estimation-based approaches offer a robust and viable alternative to traditional methods for high-precision, real-time electronic warfare applications.
B1004 17:30-17:45	Practical Challenges and Design Issues in FPGA Implementation of a CNN Accelerator Authors: Bassam J. Mohd, Khalil M. Ahmad Yousef, Ezya Khader Presenter: Bassam J. Mohd, The Hashemite University, Jordan Abstract: Field-Programmable Gate Arrays (FPGAs) are wellsuited for compute-intensive applications such as convolutional neural networks (CNNs). However, practical deployment often reveals a range of challenges that can create obstacles for researchers. This paper presents a comprehensive account of hands-on experience with Intel FPGA kits, focusing on the implementation of a Verilog-based LeNet-5 CNN. Key issues encountered include challenges in the hardware design and software development phases, including toolchain and device support limitations, integration of processors and peripherals, memory and timing constraints, as well as software–hardware mismatches and limited debugging visibility. By documenting these recurring obstacles and the strategies used to address them, the paper provides insights for researchers and engineers aiming to enhance productivity in FPGA-based design and research. Finally, we conclude the paper with important recommendations for future FPGA work.
B2070 17:45-18:00	Geometry Dependent 2D CRLB Maps for Azimuth and Elevation Direction of Arrival Estimation in MIMO Radar Arrays Authors: Moustafa S. A. Mohamed, Wassim Alexan, Diaa E. Fawzy and A. M. M. A. Allam Presenter: A. M. M. A. Allam, Faculty of IET, German University in Cairo - Egypt Abstract: In coherent imaging radars, the antenna-element distribution is a primary design variable because it governs the virtual sampling of the wavefront and therefore the ambiguity and accuracy of 2D direction-of-arrival (DoA) estimation. Although MIMO radars enable a virtual array whose aperture can exceed the physical layout, arrays with equal virtual aperture spans can still exhibit markedly different DoA performance due to geometry and directiondependent sensitivity. This paper introduces 2D Cram´er–Rao lower bound (CRLB) matrices for azimuth and elevation as DoA-dependent accuracy maps that complement ambiguity function metrics. Under a unified evaluation criteria set with fixed channel budget, SNR, field of view and identical virtualaperture size, three representative geometries are compared: uniform linear, uniform circular, and sparse. While all three geometries share the same theoretical angular resolution, the ambiguity sidelobes and the CRLB maps vary strongly with each of them, and the CRLB further varies across the field of view. These results confirm that angular resolution is a size-only descriptor, whereas 2D CRLB matrices

	provide a physically meaningful accuracy measure for comparing and designing MIMO radar antenna distributions under equal aperture constraints.
B4228 18:00-18:15	A Low-Cost Modular Micro Inverter Control Platform for Grid Connected EV Charging Systems Authors: Mahir Dursun, Ahmet Aksöz and Alper Gorgun Presenter: Alper Gorgun, Nevşehir Hacı Bektaş Veli University, Turkey Abstract: Reducing the negative impacts of non-renewable fossil-based energy sources on climate change has become a global objective across various disciplines. The rapid replacement of internal combustion engine vehicles by electric vehicles (EVs) to lower carbon emissions increases the demand for efficient, scalable, and low-cost charging infrastructures supported by renewable energy. This study presents the design and implementation of a Raspberry Pi 5-based, low-cost, and modular micro-inverter control platform supporting bidirectional power flow (V2G/V2X) for grid-connected EV charging systems. The novelty of the system lies in the integration of a Quasi-Z-Source Boost (qZSB) converter, which offers high voltage gain with a reduced component count, and a 5-level Packed U-Cell (PUC) inverter topology ensuring low Total Harmonic Distortion (THD). An advanced digital signal processing-based control strategy, leveraging the high computational capacity of the Raspberry Pi 5, has been developed to manage complex power flows between solar energy, the grid, and EVs, while optimizing inverter performance and maintaining seamless grid synchronization. Experimental results confirm that the platform exhibits high efficiency, stable operation, and effective grid power quality compliance under dynamic load conditions and grid-interactive modes. The developed hardware architecture significantly reduces system complexity and cost, providing an economically and technically viable solution for next-generation smart microgrids and EV charging stations.
B3117 18:15-18:30	Parameter Extraction of Photovoltaic Cells Using Swarm Intelligence Based Optimization Techniques Authors: Touqeer Ahmed, Uroosa Raza, Zohaib Raza, Mazhar Hussain Baloch and Muhammad Amir Raza Presenter: Touqeer Ahmed, A Sharqiyah University Oman, Oman Abstract: Solar photovoltaic (PV) has potential as an alternative source of renewable energy source compared to conventional fossil fuels. Owing to its low cost of generating power, overwhelming increase in development and application of solar PV systems has been witnessed in the recent years to sustain the ever-growing load demand. Nevertheless, the effectiveness of solar PV systems depends primarily on the choice of the best parameters, and such a choice is not very easy given the unpredictability of the variable nature of the solar irradiance. To regulate the PV cell parameters to follow its maximum power point (MPP), maximum power point tracking (MPPT) is a scheme popularly used that is not accurate and efficient. Contrarily, optimization methods based on swarm intelligence are more appropriate in addressing the PV parameters extraction problem. The paper optimizes the model parameters of the PV cell by a hybrid optimization methodology that is a hybrid of Jaya and Rao methods with no hyper-parameter. The efficiency of the suggested optimization method is considered regarding the

	model of a PV cell (DDM) because of its chosen moderate structure and complexity. The performance of the proposed and competitive techniques is analyzed based on the attained minimum root mean square error (RMSE) values from these techniques. The study's findings show that the proposed hybrid technique attains 1% to 12.5% more reduced RMSE values for PV's DDM model against the conventional Jaya, Rao, and particle swarm optimization (PSO) techniques, with a negligible increase in computational time. Overall, the proposed study has significant implications for developing eco-friendly energy sources, which are essential for addressing the challenges of a sustainable future.

Online Session 1

Power Systems, Transmission & Distribution Technologies

- **Session Chair**: Mohamed Amine BEN AISSA, University of Sciences and Technology Houari Boumediene (USTHB), Algeria
- **Time**: 09:30-11:35, April 29
- **Online Room**: Room A (872 1281 1832)
- **Papers**: Invited Speech B3115 B3146 B3153 B3155 B4174 B4195 A39

Invited Speech
09:30-09:50

Assoc. Prof. Ir. Ts. Dr. Mohamad Nur Khairul Hafizi Rohani
Universiti Malaysia Perlis, Malaysia

Benchmarking CNN and Vision Transformer Models for Small-Dataset PRPD Classification in High-Voltage Rotating Machines

Abstract: Partial discharge (PD) analysis plays a critical role in assessing insulation condition in high-voltage rotating machines. Phase-Resolved Partial Discharge (PRPD) pattern classification enables early fault detection and condition-based maintenance. Recently, Vision Transformers (ViTs) have demonstrated superior performance in various computer vision tasks; however, their effectiveness on small industrial diagnostic datasets remains uncertain. This paper presents a comparative evaluation of convolutional neural networks (CNNs) and Vision Transformer architectures for multi-class PRPD pattern classification. Five-fold stratified cross-validation was conducted on a six-class industrial PRPD image dataset. We evaluated ResNet18, EfficientNet-B0, DeiT-Tiny (head-only fine-tuning), and ViT-Base with LoRA adaptation. Experimental results show that CNN-based models significantly outperform transformer-based architectures on limited-data PRPD scenarios. ResNet18 achieved the highest mean performance (Accuracy: 89.6%, F1-score: 85.6%), whereas transformer models exhibited unstable convergence and poor generalization. The findings indicate that CNN inductive biases remain advantageous for small-scale industrial diagnostic datasets.

B3115 09:50-10:05	Analysis and Mitigation of Harmonics on Distribution Systems with Nonlinear load Authors: Saheed Lekan Gbadamosi, Oyeniyi Akeem Alimi, Folorunso Oladipo, Osonuga Babajide Taiwo, Bukola Fatimoh Gbadamosi, Oyedele Olusola Joel

	Presenter: Saheed Lekan Gbadamosi, BOWEN University, Nigeria Abstract: This paper presents an analysis and modeling of harmonics generated by non-linear loads in a distribution power system. It assesses the characteristics of harmonics and behavior of several supplies commonly found in residential and industrial settings. Models for both linear and non-linear systems were developed using MATLAB/Simulink to quantify the harmonic contributions from these loads. To address the issue of harmonic distortion, an active power filter was designed and implemented. The study demonstrates a significant reduction in harmonic distortion on the distribution system with the inclusion of the active power filter.
B3146 10:05-10:20	Entropy-Based Characterization of Partial Discharge Behavior in Void Defects of High Voltage Solid Insulation Authors: Abdurrawof Abdul Rahim, Mohamad Nur Khairul Hafizi Rohani, Norfadilah Rosle, Noor Fazliana Fadzail, Ting Meng Chew, Afifah Shuhada Rosmi and Firdaus Muhammad-Sukki Presenter: Abdurrawof Abdul Rahim, UNIVERSITI MALAYSIA PERLIS, Malaysia Abstract: Partial discharge (PD) is an important indicator of insulation degradation in high-voltage systems, and its accurate characterization is crucial for early fault detection. This study investigates PD behavior in void defects with different materials (air, metal, and water) and diameters (0.5 mm, 1.0 mm, and 1.5 mm) using entropy-based analysis. Shannon Wavelet Entropy (SWE) and Sample Entropy (SampEn) are applied to evaluate signal complexity from PRPD data.The results show that entropy values vary significantly with defect type and size. Water-filled voids exhibit decreasing entropy with increasing diameter, indicating more stable discharge behavior, while metal voids show increasing entropy, reflecting higher nonlinear complexity. An inverse relationship between entropy and regression R^2 is observed, suggesting that more complex signals are less linearly predictable. Overall, the findings demonstrate that entropy-based features are more sensitive than conventional linear methods and provide a more comprehensive understanding of PD behavior.
B3153 10:20-10:35	Advanced Electrical Tree Segmentation in High-Voltage Insulation Using U-Net with Tversky Loss Function Authors: Uthayakumar Satyaseelan, Mohamad Nur Khairul Hafizi Rohani, Mohd Annuar Mohd Isa, Afifah Shuhada Rosmi, Cik Siti Khadijah Abdulah, Wan Azani Wan Mustafa and Firdaus Muhammad-Sukki Presenter: Uthayakumar Satyaseelan, UNIVERSITI MALAYSIA PERLIS, Malaysia Abstract: Electrical treeing is a primary failure mechanism in polymeric high-voltage (HV) insulation, yet automated characterization of tree structures remains unsolved. This paper evaluates U-Net semantic segmentation with two loss function configurations BCE-Dice (baseline) and Tversky loss (proposed) for pixel-level electrical tree segmentation on 14 optical microscopy specimens with severe class imbalance (25:1 background-to-foreground ratio, mean 4.2% tree occupation). Leave-one-out cross-validation is used throughout. The Tversky configuration (α=0.3, β=0.7) with data augmentation achieves sensitivity of 0.870 ± 0.102, a 16.6%

	improvement over BCE-Dice (0.746 ± 0.233), with comparable Dice (0.586 vs. 0.615) and MCC of 0.602, while converging approximately 2× faster. Both deep learning models substantially outperform classical baselines (Otsu, Canny, Sobel, Kirsch), with Dice improvements of 2.2× and sensitivity improvements of 2.1× over the best classical method. Inference time is 50 ms per image, supporting deployment in condition-based maintenance workflows. Results establish automated deep learning segmentation as technically viable and practically relevant for HV infrastructure reliability.
B3155 10:35-10:50	Comparative Evaluation of Pretrained Convolutional Neural Networks for PRPD Pattern Classification in High-Voltage Rotating Machines Authors: Nik Nuraina Fadhilah Nik Muhammad Nasir, Aiman Ismail Mohamed Jamil, Mohamad Nur Khairul Hafizi Rohani, Mohd Annuar Mohd Isa, Aimi Salihah Abdul Nasir, Afifah Shuhada Rosmi, Ahmad Syukri Abd Rahman and Mohd Helmy Halim Abdul Majid Presenter: Nik Nuraina Fadhilah Nik Muhammad Nasir, UNIVERSITI MALAYSIA PERLIS, Malaysia Abstract: This study evaluates transfer learning using pretrained Convolutional Neural Networks for automated classification of phase-resolved partial discharge images from high-voltage rotating machines. Five architectures—EfficientNet-B0, ResNet50, DenseNet-121, MobileNetV2, and NASNetMobile—were trained on a real-field dataset representing six insulation defect types. Performance was assessed using accuracy, precision, recall, and F1-score. ResNet50 achieved the highest accuracy of 84.21%, while EfficientNet-B0 provided competitive performance with lower computational requirements. The findings demonstrate the effectiveness of transfer learning for PRPD pattern recognition under limited data conditions and highlight the suitability of deep residual networks for reliable condition monitoring applications.
B4174 10:50-11:05	Process bus synchronization effect on the digital substation protection system Author: Amneh Almbaideen Presenter: Amneh Al-Mbaideen, Mutah University, Jordan Abstract: This paper addresses the problem of process bus synchronization in digital substations, emphasizing communication protocols and time synchronization methods. It identifies IEC 61850-based protocols, particularly Sampled Values (SV) and Generic Object Oriented Substation Event (GOOSE), as critical for reliable data exchange. Precision time protocols like IEEE 1588 PTP to effectively achieve sub-microsecond synchronization. The integration of these protocols is essential for enhancing digital substation performance and interoperability. It is recommended to actively test the synchronizing status by capturing Ethernet traffic with a network protocol analyzer like Wireshark. To implement a central GPS Time Source to distribute a 1 Pulse Per Second (1 PPS) signal simultaneously to the external device under test and the GTSYNC card. Rigorous microsecond-level synchronization cannot be achieved, limit the implemented protection schemes to those that rely exclusively on signal magnitude.

B4195 11:05-11:20	An Explainable Deep Learning Framework for Multi-Horizon Electricity Load Forecasting Authors: Omnia A. Yacoub, Mohamed Hassan, Ahmed Osman Presenter: Omnia Yacoub, American University of Sharjah, United Arab Emirates Abstract: This study presents an explainable deep learning framework for multi-horizon electricity load forecasting (ELF) evaluated on the heterogeneous real-world Korean daily demand dataset (2013–2024). A strict same-target evaluation protocol is introduced to enable fair comparison across forecasting horizons by aligning predictions to identical target timestamps. The proposed architecture integrates Variable Selection Networks (VSN), Gated Residual Networks (GRN), and multi-head temporal attention within an encoder-based structure to capture nonlinear short- and long-term dependencies while preserving interpretability. Benchmarking against statistical, tuned ML, and DL baselines across 1-, 7-, and 14-day horizons demonstrates superior accuracy and stable performance degradation with increasing prediction distance. A comprehensive explainability framework combining intrinsic interpretability with SHapley Additive exPlanations (SHAP), permutation importance, and sensitivity analysis reveals dominant contributions from load-history and calendar features, while exogenous variables gain importance at longer horizons.The proposed framework therefore provides accurate, stable, and transparent ELF suitable for decision support in modern power systems.
A39 11:20-11:35	Comparative Analysis of Hybrid CNN–LSTM and CNN–TCN Models for State of Charge Estimation in Li-ion Batteries Suna Oğur, Saadin Oyucu, Hüseyin Polat, Ahmet Aksöz, Emre Biçer, Mahir Dursun Presenter: Emre Bicer, Gazi University, Turkey Abstract: Accurate estimation of the State of Charge (SoC) is essential for ensuring the reliability of battery management systems in electric vehicles. However, the nonlinear electrochemical behavior of Li-ion batteries and their sensitivity to variables such as temperature and current make high-accuracy SoC estimation challenging. In this study, a hybrid deep learning–based approach is proposed for SoC estimation, and single models including Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), and Temporal Convolutional Network (TCN), together with hybrid models (CNN-LSTM, CNN-TCN, and TCN-LSTM), are comparatively evaluated. Multivariate time-series data consisting of battery voltage, temperature, charge rate, and cycle index were processed using the sliding window method, and the models were trained using an 80% training and 20% testing data split. Experimental results show that the CNN–LSTM hybrid model achieved the highest prediction accuracy with MAE = 1.093, RMSE = 2.405, and R2 = 0.993. In addition, the single CNN model achieved R2 = 0.990, while the CNN–TCN model obtained R2 = 0.980. The findings demonstrate that hybrid architectures combining local feature extraction with temporal modeling provide an effective and reliable solution for SoC estimation.

Online Session 2.1

Control Systems, Automation & Computing Technologies

- **Session Chair:** Mohamed Orabi, The American University in Cairo, Egypt
- **Time**: 09:30-12:05, April 29
- **Online Room**: Room B (894 4933 0640)
- **Papers**: **Invited Speech** B1011 B2063 B2076 B3124 B3138 B4177 B2049 B3119 B4001

Invited Speech
09:30-09:50

Assoc. Prof. Shuang Du
The University of Electronic Science and Technology of China, China

MAPSE: A Decoupled Planning and Execution Framework for Robust Vision-Language-Action Robots

Abstract: Vision-Language-Action (VLA) models show great promise for multi-task robotic manipulation, but their real-world deployment is hindered by limited out-of-distribution (OOD) robustness, a lack of hierarchical task decomposition for long-horizon reasoning, and insufficient fault tolerance. To address these challenges, this paper proposes MAPSE, a decoupled planning-execution framework designed to achieve modular generalizability and execution recoverability. At the planning level, MAPSE utilizes a multimodal episodic memory hub, employing a Pareto multi-objective retrieval mechanism and task skeleton re-ranking to ensure candidate diversity and structural alignment. Furthermore, an adaptive threshold-gated strategy dynamically balances efficiency and generalization by toggling between semantic mapping transfer and retrieval-augmented MLLM planning. For robust execution, any VLA policy can be integrated as a plug-and-play action expert, monitored by a SAFE-driven closed-loop failure detection mechanism at the sub-task level. Upon identifying a failure trend, a spatial-aware MLLM synthesizes geometric correction prompts to trigger targeted recovery trajectories. Crucially, to prevent control stagnation during MLLM inference, we introduce a latency aware asynchronous parallel recovery mechanism. Extensive evaluations demonstrate that MAPSE significantly improves both the success rate and closed-loop robustness of existing VLA policies. Notably, our framework achieves state-of-theart mean success rates of 97.9% on the LIBERO simulation benchmark and 79.7% on SimplerEnv-WidowX, alongside superior continuous performance in complex, multi-stage real-world manipulation tasks.

B1011 09:50-10:05	KAI-9: An AI-Powered Smart Robotic Police Dog for Real-Time Security Authors: Sofian saidi, Shahad Alsuweidi, Salama Almheiri Presenter: Sofian saidi, Electrical Engineering Technology, United Arab Emirates Abstract: The design and deployment of KAI-9, an AI-enabled robotic police dog created as a cutting edge substitute for conventional K9 units for security and law enforcement purposes, is presented in this paper. Technology improves safety in high risk areas like police stations, jails, and airports by combining real time data processing, artificial intelligence, and sophisticated sensor technologies. KAI-9 is capable of a number of security tasks, such as temperature or stress monitoring, substance detection, and facial recognition. An onboard computer processes all sensor data, which is then shown on a specially designed dashboard that offers visual statistics, incident reports, and real-time warnings for quick decision making. The potential of KAI-9 to assist cops by offering automated threat assessment and continuous surveillance was confirmed by experimental testing, which showed dependable system performance and excellent detection accuracy. The prototype is an example of a scalable, ethical, and cost-effective robotic solution that integrates AI and IoT to advance the next generation of smart security systems.
B2063 10:05-10:20	Integration of a Robotic Arm Grasping System with Deep Learning for Adaptive Manipulation in Agriculture Authors: Wanwan Xu, Zian Wang and Mudarmeen Munlin Presenter: Mudarmeen Munlin, Mahanakorn University, Thailand Abstract: Deep learning has substantially improved visual object perception; however, its integration into physical robotic systems for delicate manipulation remains challenging due to real-time control, uncertainty, and safety constraints. This paper presents an integrated robotic grasping framework that couples deep visual perception with real-time control to enable gentle and adaptive apple handling in unstructured environments. The system builds on a CNN-based detector and employs a modular architecture consisting of visual sensing, intelligent grasp decision-making, and precision robotic execution implemented in PyBullet. Visual detections are converted into executable grasp commands through reasoning over geometric stability, approach angles, and contact forces, with realistic sensor noise and dynamics modeled in simulation. Implemented in Python using PyTorch and OpenCV, the proposed pipeline achieves a grasp success rate of 92.3% with an average latency of 185 ms and a damage rate below 1.2%. Experimental results demonstrate significant improvements over rule-based baselines, highlighting the framework's robustness, adaptability, and applicability to agricultural and industrial robotic manipulation tasks.
B2076 10:20-10:35	Fuel Cell Air Supply System Control Using Deep Q-Network Authors: Emir Oğuz, Ahmet Onat Presenter: Emir Oğuz, İstanbul Technical University & AVL Turkey Research and Engineering, Turkey Abstract: Proton exchange membrane fuel cells (PEMFCs) are a promising clean energy technology for transportation. The oxygen excess ratio (OER)

	is an important number that affects the net power output, system efficiency, and long-term durability of PEMFCs directly. To avoid oxygen starvation, which can cause irreversible membrane damage and shorten the life of the cell, it is important to keep the OER value at the right level. This paper introduces an innovative deep Q-network (DQN) based reinforcement learning methodology for adaptive OER control in PEMFC air supply systems. The proposed controller deals with the fact that the cathode air path is nonlinear and changes over time, such as when the compressor's dynamics and the supply manifold pressure change. The DQN agent learns the best way to control the system by interacting with the model and maximizing a reward function that is meant to balance OER tracking performance with net power optimization. Simulation results show that the DQN controller works better than other controllers, especially when the load is changing. The intelligent controller effectively decreases time spent within dangerous region when current demand changes quickly, which lowers the risk of oxygen starvation and makes the system more reliable.
B3124 10:35-10:50	Intellectualized Decision Support System for Controlling the High-Quality Sulfur Production Process Authors: Batyr Orazbayev, Ainur Zhumadillayeva, Kulman Orazbayeva and Ramazan Yessirkessinov Presenter: Ramazan Yessirkessinov, Kazakh-British Technical University, Kazakhstan Abstract: An approach to the development of an Intelligent Decision Support System (IDSS) for optimal control of the highquality sulfur production process under conditions of uncertainty and fuzziness is proposed. The relevance of this study is due to the complexity and nonlinearity of the sulfur production process, which is characterized by fuzziness of certain parameters and high sensitivity of sulfur quality to fluctuations in operating conditions. A hybrid method based on the systematic use of neural networks and fuzzy logic is proposed. Using this method, neuro-fuzzy models of the high-quality sulfur production process were developed, enabling effective control of the process under conditions of uncertainty and fuzziness. The structure of the IDSS is created, and its main interrelated subsystems, modules, and elements are described. The scientific novelty of this work lies in the development of an IDSS for controlling the high-quality sulfur production process based on the integration of expert knowledge and artificial intelligence methods. The practical significance is determined by the possibility of applying the proposed system in real operating conditions of sulfur production units to improve sulfur quality and enhance process stability. In addition, the use of artificial intelligence methods and expert knowledge increases the efficiency and robustness of the technological process
B3138 10:50-11:05	A Practical In-Memory Data Management Approach for Improving Microservice Performance Authors: Muzaffer Diler, Kaya Oğuz Presenter: Kaya Oğuz, Izmir University of Economics, Turkey Abstract: The purpose of this study is to demonstrate the advantages of keeping the cached data consistently in memory, in an approach we call ``Data in Memory''. Using the pub/sub pattern, the microservices keep the

	data of the required microservices in memory and in return the microservices publish their changes to the subscribed services. By eliminating redundant network calls, this approach reduces latency and inter-service coupling while trading minimal additional memory for significant runtime gains. Experimental results show that the average response time has been cut in more than half, from 300 ms to 130 ms, the median response time has dropped to 50 ms from 150 ms on average, and the Apdex score of the system has increased to 0.96. These increases came only with an increase of memory usage, from an average of 300K to 550K. The results indicate that the proposed data in memory approach provides a scalable, low-overhead alternative to conventional caching strategies in microservice architectures, particularly suitable for systems that prioritize responsiveness and availability.
B4177 11:05-11:20	Dynamic Modeling and Trajectory Tracking Control Simulation of a 2-DOF SCARA Robot: An Analytical and Numerical Approach Authors: Yağmur Özmen, Ahmet Saygın Öğülmüş, Hikmet Bal Presenter: Hikmet Bal, OSTİM Technical University, Turkey Abstract: This paper presents the dynamic modeling, trajectory planning, and control of a two-degree-of-freedom (2- DOF) Selective Compliance Assembly Robot Arm (SCARA). The complete equations of motion (EoM) are derived using the Lagrangian formulation, and the nonlinear system is expressed in state-space form for analysis and controller design. An inverse dynamics approach is implemented to compute the required joint torques for prescribed end-effector trajectories, while inverse kinematics is used to map Cartesian coordinates to joint space. Linear and circular trajectory profiles are considered to evaluate system performance. A Ziegler–Nichols–tuned PID controller is applied for closedloop trajectory tracking, and its performance is compared with that of open-loop inverse dynamics under sensor noise and initial condition disturbances. The results demonstrate a significant reduction in tracking error and improved disturbance rejection capability. The proposed framework is validated through MATLAB/Simulink simulations, providing accurate predictions of joint positions, velocities, and torque requirements. The study offers a practical and computationally efficient approach for SCARA robot analysis and control in industrial applications.
B2049 11:20-11:35	Exploration of Multiply-accumulate Arithmetic Unit Designs for AI Applications Authors: Fadi N. Sibai, Ali El-Moursy and Karam Alshouraa Presenter: Fadi Sibai, Gulf University for Science and Technology, Kuwait Abstract: Hardware acceleration for Transformer models is critical for enabling real-time artificial intelligence. The selfattention mechanism, built upon a computationally intensive dot-product operation, remains a primary performance bottleneck. This paper proposes a pipelined, parallel-multiplyaccumulate (MAC) accelerator for self-attention, focusing on the Integer MAC pipeline. We present a parameterized Verilog implementation featuring P parallel multiplication units and a pipelined adder-tree accumulator. Synthesis results on an Intel Cyclone V FPGA characterize the impact of word-length (W) and parallelism (P) on frequency, area, and power. We report performance metrics enabling comparative design

	selection for edge AI applications.
B3119 11:35-11:50	Campus Surveying Using Autonomous Drones for Crowd Monitoring Authors: Omair Jagirdar, Rakesh M, Yashaswini N, Bajarangbali R Presenter: Omair Jagirdar, PES University, Bengaluru, Karnataka Abstract: Running computer vision on drones in real time can be challenging due to computational and communication latency. To avoid these issues, we developed an edge-computing solution for drones using two different hardware computers. The Raspberry Pi 4, which is attached to the drone, runs the computer vision algorithms to detect humans. The CrossFlight controller, which is the computer that controls the drone's flight, stays on the drone's base to avoid the impact of vibration from the drone's motors. Field evaluations demonstrated an 88% detection accuracy at operational altitudes across standard university settings, while maintaining a waypoint navigation error margin of 1.5m With flight times reaching 18 minutes and with an end-to-end processing delay of approximately 180,ms, the identified technology presents a cost-effective means of monitoring the vast areas belonging to these institutions.
B4001 11:50-12:05	A Floating-Point Vector ANN Architecture on SoC-FPGA for Real-Time Estimation of GMAW Bead Geometry Authors: Bruno Mota de Souza, Guillermo Alvarez Bestard and Renato Coral Sampaio Presenter: Bruno Mota de Souza, Post Graduation Program in Mechatronics Systems (PPMEC), University of Brasilia, Brazil Abstract: Traditional destructive testing methods for welding products limit real-time quality assurance. This work addresses this challenge by presenting a non-destructive methodology with the employment of artificial neural network (ANN) embedded in FPGA to predict weld bead penetration, reinforcement and width during the Gas Metal Arc Welding (GMAW) process in real-time. In addition to quality verification, the methodology enables the system to be integrated into a closed-loop control framework, making dynamic adjustments of welding parameters possible based on the real-time geometric estimations. The experimental setup integrates thermographic sensors and laser profilometers into a motorised and controlled welding system. Data acquisition and preprocessing are handled within the Linux-based environ- ment of the SoC FPGA, while the ANN inference is executed in the Programmable Logic for high-speed and parallel calculation. The ANN, featuring a hyperbolic tangent sigmoid transfer function, was previously trained with datasets acquired in other studies and its weights and characteristics were then implemented in VHDL with the use of calculation blocks, such as CORDIC for exponential calculation, and subtractors and multipliers in a floating-point-vector implementation. Performance benchmark- ing is provided using a 24-bit word-length configuration for all processed data vectors in the FPGA logic. Comparative analysis with conventional computer architectures demonstrates that the FPGA implementation achieves a significant reduction in latency while maintaining a high accuracy. This methodology enables a scalable path toward fully autonomous, closed-loop welding quality assurance.

Online Session 3

Power Electronics, Electrical Machines & Drives

- **Session Chair:** Anzar Mahmood, Mirpur University of Science and Technology, Pakistan
- **Time**: 09:00- 12:00, April 29
- **Online Room**: Room C (864 5762 2005)
- **Papers**: B1034 B2064 B2066 B3105 B3157 B4203 B4207 B4208 B4199 B4202

B1034 09:30-09:45	Design of a Phase-Shifted Full-Bridge Converter for Intermediate Bus Architecture Authors: Fatih Güzelsoy, Erdem Akboy Presenter: Fatih Güzelsoy, Yildiz Technical University, Turkey Abstract: In telecommunication power systems, various loads operate at very low voltage levels (e.g., 1.2 V). Reducing the main bus voltage to much low voltage levels creates significant disadvantages, especially at high current values. Therefore, the use of intermediate DC-DC converters is beneficial in modern telecommunications power systems. Moreover, high efficiency, high power density, galvanic isolation, stable control characteristics and reliability are desired at the applications. Intermediate Bus Converter (IBC) applications provide an intermediate step for voltage conversion within such architectures. This study presents the design, simulation, and evaluation of a 480 W Phase-Shifted Full-Bridge (PSFB) DC-DC converter intended for intermediate stage use in telecommunication power systems. The proposed converter topology provides Zero Voltage Switching (ZVS) for the switches, significantly reducing switching losses and improving overall system efficiency.
B2064 09:45-10:00	Fuzzy–PI Control of a Stacked Interleaved Buck Converter for PEM Electrolyzer Applications Authors: Abderrahman Miss and Mohammed Ouassaid Presenter: Abderrahman MISS, Mohammed V University in Rabat, Morocco Abstract: Proton Exchange Membrane (PEM) electrolyzers require tightly regulated DC current with minimal ripple and fast transient response to ensure efficiency, stability, and long-term durability. This work develops an analytical and control-oriented model of the Stacked Interleaved Buck Converter (SIBC), a topol- ogy capable of achieving intrinsic ripple cancellation through complementary phase operation and series-capacitor decoupling. A Fuzzy–PI controller is designed to enhance the converter's dynamic response by adaptively tuning the proportional and integral gains according to the instantaneous error trajectory. Numerical results show that, compared with a Gain-Scheduled PI (GS-PI) approach, the proposed method fully suppresses the transient overshoot and shortens the settling time by approxi- mately 8.1%.
B2066	Multiport Isolated DC-DC Converter for PV-Battery Integration in DC

10:00-10:15	Microgrids Authors: brahim Abuishmais, Hussain Sabri, Ahmad Barakat and Jad Akl Presenter: Ibrahim Abuishmais, Princess Sumaya University for Technology, Jordan Abstract: With the increasing integration of renewable energy sources and the transition to DC-based loads, the demand for DC-DC multiport converters is growing. However, many existing multiport converters are limited to either multiple inputs or outputs. This paper presents an isolated DC-DC converter with multi-input and multi-output capability, enabling flexible energy management among diverse sources and loads. Multiple control strategies are incorporated to ensure robust and stable multiport operation under realistic conditions. The system is simulated using PSIM tool, and its performance is evaluated under various realistic scenarios, including load variations, PV shading, and fault conditions. Results demonstrate high efficiency of 97.5%, successful voltage regulation with minimal ripple, robust dynamic performance, and system continuity across different operating scenarios and fault conditions.
B3105 10:15-10:30	Design and Simulation of a Floating Capacitance Multiplier with Extremely Large Multiplication Factor Authors: Abeer Ahmed and Muneer Al-Absi Presenter: Abeer Rashed Ahmed, KFUPM, Saudi Arabia Abstract: This paper presents the design and simulation of a floating capacitance multiplier (FCM) capable of achieving an extremely high multiplication factor. The proposed configuration employs six active building blocks, including one voltage-differencing buffered amplifier (VDBA), four modified second-generation current conveyors (M-CCIIs), and one dual M-CCII, together with a single grounded resistor and a small-valued grounded capacitor. This structure eliminates the need for bulky passive components, enabling compact implementation and suitability for full CMOS integration. The circuit is designed using 180-nm TSMC CMOS technology and validated through Cadence simulations under a low supply voltage of ± 0.9 V. The proposed FCM achieves a capacitance multiplication factor exceeding 75K with a low cutoff frequency suitable for biomedical (ECG, EMG, and PCG) applications, demonstrating a significant improvement over existing designs. The circuit exhibits stable frequency characteristics and maintains its capacitive behavior over a wide operating range, confirming accurate impedance realization. In addition to temperature robustness, Monte Carlo (MC) analysis is performed to evaluate the impact of process variations. The results demonstrate a near-Gaussian distribution of impedance with a low coefficient of variation of approximately 6.65%, confirming minimal sensitivity to device mismatches and strong process tolerance. Furthermore, the design demonstrates low power consumption and efficient operation under reduced supply conditions. The results confirm that the proposed architecture offers an effective trade-off among high multiplication factor, accuracy, circuit complexity, and power efficiency, making it well-suited for integration into advanced analog and mixed-signal systems.
B3157 10:30-10:45	Design of Switched Reluctance Motor for Unmanned Aerial Vehicle Applications

	Authors: Ulaş Duran, Yusuf Yasa Presenter: Ulaş Duran, Istanbul Technical University, Turkey Abstract: This study proposes a switched reluctance motor (SRM) with a magnet-free rotor architecture to address the supply chain risks, long lead times, and thermal limitations associated with rare-earth-based brushless DC (BLDC) motors. It presents the mathematical foundations of the design process, the electromagnetic design utilizing finite element analysis (FEA), and comprehensive performance evaluations specifically tailored for unmanned aerial vehicle (UAV) propulsion. Furthermore, the proposed magnet-free design enables rapid acceleration and high-speed operation without concerns regarding magnetic degradation or thermal demagnetization. The electromagnetic design results demonstrate that the optimized motor fulfills the required performance criteria. This study validates the feasibility of SRMs as a sustainable, strategically advantageous, rapidly manufacturable, and cost effective alternative for next generation drone applications.
B4203 10:45-11:00	Improving Efficiency of Asymmetrical Multilevel Inverters: A Comparative Power Loss Analysis of 3, 5, 7, 9 and 11-Level Configurations Authors: Md. Kamrul Islam, Sakhawat Hossen Rakib, Tapan Kumar Chakraborty Presenter: Md. Kamrul Islam, University of Asia Pacific (UAP), Bangladesh Abstract: This paper presents a comparative study of power losses in asymmetrical cascaded multilevel inverters (MLI) over five voltage levels: 3, 5, 7, 9 and 11 levels. This asymmetric architecture attains elevated voltage levels while minimizing component count by the utilization of disparate DC source ratios. A comprehensive analysis of switching losses, conduction losses, harmonic losses and control circuit losses is performed with actual IGBT specifications (TO-247, 600V, 40A) at a power factor of 0.95. The findings indicate that the 7-level asymmetric arrangement attains a maximum efficiency of 74.79% with merely 8 switches, whilst the 11-level configuration achieves 74.96% efficiency utilizing 12 switches. This study demonstrates that asymmetric layouts provide 7-level output while maintaining the same switch count as traditional 5-level designs. Harmonic analysis indicates a reduction in total harmonic distortion from 37.28% (3-level without filter) to 10.77% (11-level with LC filter). The 5-level arrangement provides the optimal cost-performance ratio, achieving 18.68% efficiency and 18.68% total harmonic distortion with merely 8 switches. A comparative comparison of filtered and unfiltered outputs reveals that LC filtering decreases total harmonic distortion (THD) by 0.5 to 10 percentage points, contingent upon the voltage level. This study offers pragmatic advice for the selection of asymmetric MLI, focusing on efficiency, harmonic performance and the equilibrium of component count.
B4207 11:00-11:15	An Asymmetrical Half-Bridge Flyback Converter with Integrated Power Factor Correction Authors: Alireza R. Ghanbari, Sonali K. Sonawane Presenter: Sonali K. Sonawane, V-Research GmbH, Austria Abstract: This paper proposes a modified asymmetrical half-bridge flyback (AHBF) converter with integrated power factor correction (PFC) based on

	discontinuous capacitor voltage mode (DCVM) operation. By incorporating a coupled inductor network into the conventional AHBF structure, the proposed topology achieves inherent input current shaping without requiring an additional PFC stage or complex control. The operating principle of the proposed converter is analytically investigated, and the theoretical analysis is validated through experimental results.
B4208 11:15-11:30	Hardware Architecture of a 72V, 3.5kW BLDC Motor Driver for Light Electric Vehicles Authors: Okan Köse, Haşim Osman Bilici, Mısra Baran, Eymen Karakoyunlu, Mehmet Sezgin Presenter: Okan Köse, Istanbul Commerce Universty, Turkey Abstract: The rapid spread of light electric vehicles (LEV) increases the need for highly efficient and reliable motor drives. The main goal of this study is to design a unique BLDC motor driver hardware that can produce 3.5kW continuous power at 72V rated voltage, tolerant to large battery voltage fluctuations (50V-84V) and high safety standards. For this purpose, a multi-layered power and control system has been developed based on a high-performance 32-bit microcontroller and intelligent gate driver architecture. Thermal losses were minimized by choosing power MOSFETs with ultra-low transmission resistance on the power floor, and the CAN Bus communication infrastructure was included in the design for the uninterrupted in-vehicle integration of the system. This hardware architecture provides an electrically and thermally secure, scalable prototype infrastructure for high-power density e-mobility systems prior to physical production.
B4199 11:30-11:45	Analytical Review of Linear Reluctance Motors Authors: Sarah Shaker Hareer and Diyah Kammel Shary Presenter: Sarah Shaker Hareer, Dept.of Electrical Engineering Techniques, Iraq Abstract: Linear Reluctance Motors (LRMs) have attracted increased attention recently as a promising type of linear electric motor for direct-motion uses. Because of their simple mechanics, the absence of permanent magnets, and inherent fault tolerance, they represent attractive substitutes for traditional linear motor technologies operating in harsh environments. In spite of the mentioned advantages, machine design, magnetic nonlinearity, and control strategy greatly influence the electromagnetic properties and performance of Linear Reluctance Motors (LRMs). This makes designing even more complicated.This article provides a comprehensive survey of linear switching reluctance motors, with the main focus on their basic operation modes, machine designs, models, power electronic drives, and control methods. We critically evaluate common analytical methods like reluctance network models,flux-based analytical techniques, and finite element analysis to show their pros and cons.
B4202 11:45-12:00	A Distributed V2X Communication Architecture for Delay-Resilient Route Guidance Systems Authors: Halah Alabdouli, Mohamed Hassan, Akmal Abdelfatah Presenter: Halah Alabdouli, Higher Colleges of Technology, UAE

	Abstract: Intelligent Transportation Systems (ITS) are designed to improve traffic efficiency and urban mobility, with Route Guidance Systems (RGS) playing a central role. However, the impact of communication architecture on the reliability and performance of route guidance has not been thoroughly explored. Most existing studies tend to treat communication technologies and routing strategies separately, despite their strong interdependence. To achieve effective route guidance, communication frameworks must meet strict latency and reliability requirements. We introduce VORTINET (Vehicular Optimal Route Traffic Infrastructure Network), a distributed traffic management framework built on a two-tier communication architecture. The system combines VANET-based vehicle-to-vehicle and vehicle-to-infrastructure communication for localized information exchange, alongside 5G-based infrastructure-to-infrastructure communication for broader network coordination. To evaluate its performance at different levels of congestion, we use a hybrid simulation environment that integrates Network Simulator-3 (NS-3) with Dynamic Traffic Assignment under three congestion level; Low, Medium and High. The simulation evaluates metrics such as communication delay and packet delivery ratio and their impact on route guidance performance. Our results show that while communication delays lead to only slight travel-time increases (up to 2.4%) in high traffic congestion, vehicles with access to real-time information consistently achieve faster travel times. Additionally, higher levels of information sharing improve overall traffic efficiency, demonstrating the scalability and robustness of the proposed framework.

Online Session 2.2

Control Systems, Automation & Computing Technologies

- **Session Chair**: Diaa Fawzy, Izmir University of Economics, Turkey
- **Time**: 13:00-15:20, April 29
- **Online Room**: Room A (872 1281 1832)
- **Papers**: **Invited Speech** B3156 B4172 B2071 B4217 B1027 A27 A36 B2091

Invited Speech
13:00-13:20

Dr. Mohammad Hafiz Mohd Yusof
Universiti Teknologi MARA, Malaysia

Visualizing Realistic Benchmarked IDS Dataset: CIRA-CIC-DoHBrw-2020

Abstract: Intrusion Detection System (IDS) dataset is crucial to detect lateral movement of cyber-attacks. IDS dataset will help to train the IDS classifier model to achieve earliest detection. A good near-realism public dataset is essential to assist the development of advanced IDS classifier models. However, the available public IDS dataset has long been under scrutiny for its practicality to reflect real low-footprint cyber threats, render real-time network scenario, reflect recent malware attack over newly developed DoH protocol, disregard layer 3 information and finally publish contradictory results of classification and analysis between various studies which makes it non-reproducible and without shareable results. This problem can be resolved by sophisticatedly visualizing a new realistic, real-time, low footprint and up-to-date benchmarked dataset. Visualization helps to detect data deformation before designing the optimized and highly accurate classifier model. Therefore, this study aims to review a new realistic benchmarked IDS dataset and apply sophisticated technique to visualize them. The review starts by carefully examining production network features. These are then compared with various well-established public IDS datasets. Many of them are static, unrealistic meta-features and disregard source and destination Internet Protocol (IP) information except CIRA-CIC-DoHBrw-2020 dataset. The study then applies Eigen Centrality (EC) technique from the graph theory to visualize this layer 3 (L3) information. Finally, using various visualization techniques such as Principal Component Analysis (PCA) and Gaussian Mixture Model (GMM), the study further analyzes and subsequently visualizes the data. Results show that the CIRA-CIC-DoHBrw-2020 simulated recent malware attack and has a very imbalanced dataset which reflects the realistic low-footprint cyber-attacks. The centrality graph clearly visualizes IPs that are compromised by recent DoH attack in real-time, and the study concludes

decisively that smaller packet length of size 1000 to 2000 bytes is to fit an attack trait.	
B3156 13:20-13:35	Design and Implementation of an IoT-Based Electrical Energy Monitoring and Control System Authors: Priyan Malarvizhi Kumar, Madhusudan Singh, Thangavel Murugan and Balasubramanian Prabhu Kavin, Presenter: Priyan Malarvizhi Kumar, United Arab Emirates University, United Arab Emirates Abstract: The growing need to apply intelligent energy use in intelligent homes and industry environment requires a high level of monitoring and autonomous control systems that are beyond the traditional metering systems. This paper demonstrates the design and implementation process of an IoT-Based Electrical Energy Monitoring and Control System in which a new method is used, called Predictive Edge-Based Adaptive Energy Management (PEAEM). The suggested solution involves the combination of real time energy capture, edge level processing, and smart load control into a single design. Voltage, current, power, power factor electrical parameters are continuously measured by using precision sensing modules, which are connected to a microcontroller-based edge device. PEAEM method involves embedded analytics that carry out real-time consumption profiling, anomaly, and dynamic load prioritization on the edge layer and thus minimizing latency and cloud dependency. Lightweight IoT communication protocols are used to transmit processed data to a cloud platform in order to perform remote visualization and supervisory control. The system architecture is effective in the two-way communication system, which facilitates automated decision-making and scheduling of electrical loads by the user. The proposed framework can deliver a scalable and efficient solution to smart energy management applications in residential, commercial, and distributed power systems with the help of IoT connectivity, edge intelligence, and adaptive control strategies.
B4172 13:35-13:50	Application of Fault Injection Methods to Software-Based Plc Simulation Test Processes Authors: Görkem İnci, Yavuz Şişkolu Presenter: Görkem İnci, Yavuz Şişkolu, Siemens A.S. Kartal R&D Center, Turkey Abstract: Software-based PLC simulation environments enable flexible testing of automation systems without requiring physical hardware; however, evaluating execution-time behavior under fault conditions remains challenging due to host-system dependencies. This study investigates the impact of softwareimplemented (SWIFI) and hardware-implemented (HWIFI) fault injection on PLC cycle-time behavior using a Siemens S7-1500 software controller executed in PLCSIM Advanced. Fault scenarios were systematically introduced, and cycle imes were monitored to quantify execution-time deviations. The results show that SWIFI can cause significant transient spikes, increasing cycle time from a baseline of approximately 1.9 ms to a maximum of 12.681 ms, corresponding to more than a sixfold increase. In contrast, HWIFI produces more consistent but lowermagnitude deviations, with cycle times reaching up to 9.144 ms due to interrupt handling and communication

	overhead. Mean cycle times also increased under fault conditions, indicating sustained execution overhead in addition to transient peak behavior. These findings demonstrate that cycle-time variation is primarily determined by internal fault-handling mechanisms rather than the origin of the fault. Additionally, the results highlight the influence of host-system characteristics on execution performance, emphasizing the need to account for platform-level effects when evaluating simulation-based PLC systems
B2071 13:50-14:05	A Hybrid CNN-Transformer Approach for Automated Olive Leaf Disease Classification Authors: Dilara Büker, Gökalp Çınarer Presenter: Dilara Büker, Bozok University, Turkey Abstract: In this study, a hybrid deep learning approach is proposed for the automatic classification of olive leaf diseases by integrating the complementary strengths of CNN-based architectures and the Swin Transformer. The proposed model combines the local and texture-oriented feature extraction capabilities of convolutional neural networks with the hierarchical, window-based attention mechanisms of the Swin Transformer, enabling a joint representation of both local and global visual information. The performance of the model is evaluated on an olive leaf image dataset that reflects real-world field conditions and exhibits class imbalance. Experimental results demonstrate that the proposed hybrid approach provides an effective and robust solution for the automatic diagnosis of olive leaf diseases.
B4217 14:05-14:20	Load Frequency Control of Single-Area Power Systems by Hybrid Optimization Author: S. Mert Özer Presenter: S. Mert Özer, Eskisehir Technical University, Turkey Abstract: This study proposes a hybrid optimization-based controller design method for load frequency control of single-area power systems. The approach exploits the spectral properties of the closed-loop system matrix to enhance disturbance rejection performance. In the first stage, the proportional–integral (PI) controller parameters are obtained by minimizing the spectral abscissa of the closed-loop system, which maximizes the exponential decay rate and ensures rapid attenuation of load disturbances. To the best of the authors' knowledge, the application of spectral abscissa optimization for load frequency control has not been previously investigated and therefore constitutes a novel contribution of this work. In the second stage, the time-domain performance is further improved by minimizing the integral absolute error (IAE) of the frequency deviation while imposing a constraint on the spectral abscissa to preserve the favorable stability characteristics obtained in the first stage. The effectiveness of the proposed design strategy is evaluated through simulations conducted for three different sets of system parameters representing different operating conditions of the single-area power system. The results demonstrate that the spectral abscissa optimization guarantees stable closed-loop dynamics with fast decay rates, while the subsequent constrained IAE optimization significantly improves key time-domain performance measures such as settling time and peak frequency

	deviation. The proposed method provides a systematic framework for balancing stability properties and transient performance in load frequency control systems.
B1027 14:20-14:35	Rain Leakage Monitoring and Alarm Management System Based on IoT Conductive Sensing Technology Authors: Wanwan Xu and Mudarmeen Munlin Presenter: Wanwan Xu, Mahanakorn University of Technology, Thailand Abstract: Roof leakage poses a persistent threat to building integrity, often resulting in structural damage, electrical hazards, and costly repairs. Traditional inspection methods based on manual patrols are inefficient, lack real-time responsiveness, and prone to coverage gaps. To address these challenges, this paper presents an intelligent Rain Leakage Monitoring and Alarm Management System leveraging Internet of Things (IoT) technology and conductive detection ropes. The system enables 24/7 real-time monitoring, precise leakage point localization (≤5 mm accuracy), and multi- channel alarm notification via web alerts, SMS, and on-site sound/light signals. We evaluate system performance under three water conditions: pure water, saltwater, and natural rainwater to assess sensitivity across varying conductivity levels. Experimental results demonstrate an average alarm response time of less than 5 seconds for conductive sources (rainwater and saltwater) with positioning errors consistently within 5 cm, fully meeting design specifications. In contrast, pure water (low conductivity) exhibits delayed or missed alarms due to insufficient ionic content. These findings validate the system's robustness in real-world environments and highlight the critical role of water conductivity in detection reliability. The solution offers a scalable and cost-effective platform for smart building maintenance with strong potential for large-scale industrial deployment.
A27 14:35-14:50	Anticipatory Cyber-attack Surface Analysis by Temporal Graph Representation Learning with Large Graph Transformers Authors: Abdur Rahman Sarker, Md Fahim Bin Alam, Kazi Mostofa Sakin, Md Sarowar Zahan, Md Mostafizur Rahman, Md Sanjid Khan Presenter: Abdur Rahman Sarker, Department of Applied Statistics and Data Science Abstract: The complexity in the interconnected digital infrastructures has resulted in a considerable increase in the cyber-attack surface, which has resulted in the increased susceptibility of modern networks to complex attacks. Traditional security analysis techniques are based on static models and are not effective in addressing the complex nature of the cybersecurity landscape. To address the limitations in the analysis of cyber-attack surface, this study proposes an anticipatory attack surface analysis model based on temporal graph representation learning and the use of the transformer architecture. The edges in the graph are the communication and potential attack vectors in the network. This attention mechanism helps in identifying critical nodes and connections, which might cause the spread of cyber-attacks. The performance of the proposed model is tested and compared with different approaches like the Graph Convolutional Network (GCN). The experimental results of the

	proposed model, Temporal Graph Neural Network (TGNN) with Large Graph Transformer, show that it has an accuracy of 96.8%. This shows the effectiveness of the proposed model in predicting possible attacks and identifying the vulnerable network components. The results show the effectiveness of using temporal graph learning and the transformer attention mechanism in improving the performance of attack predictions. The proposed framework is thus an effective approach for proactive analysis in cyber security against possible attacks in complex network environments.
A36 14:50-15:05	PC-CAN69: A 69-Hour High-Fidelity Dataset for Semantic and Physical Consistency-Based In-Vehicle IDS Authors: Ufuk Akkaya, Ibrahim Ozcelik Presenter: Ufuk AKKAYA, Sakarya University, Turkey Abstract: Most existing Controller Area Network (CAN) datasets focus heavily on network-layer identifiers but lack the physical context required to accurately model complex vehicle dynamics. Consequently, these datasets fall short in evaluating next-generation security solutions aimed at detecting sophisticated semantic cyber-attacks, such as masquerade and spoofing intrusions. To address this critical methodological gap, this study presents PC-CAN69: a high-fidelity, process-oriented dataset that decodes raw CAN traffic into 30 distinct physical parameters. The dataset was collected using a custom embedded data acquisition system during 69 hours of real-world active driving in a 2019 Renault Clio, resulting in over 15 million samples across diverse operating conditions. Key variables, including fuel flow rate and actual engine torque, are continuously logged, enabling detailed modeling of real vehicle dynamics. A major technical contribution of this work is that we mathematically derive manual gear positions from the deterministic relationship between engine speed and vehicle velocity, thereby reconstructing a critical latent state that is natively absent in standard protocols . By providing a nearly 50-fold increase in scale compared to foundational physical-consistency benchmarks, PC-CAN69 offers a high-dimensional resource for modeling inter-parameter mechanical dependencies. Ultimately, this work provides a scalable resource for the research community to design and validate IDS models capable of detecting advanced cyber-physical anomalies in modern automotive systems.
B2091 15:05-15:20	Improving Driver Drowsiness Detection via Personalized EAR/MAR Thresholds and CNN-Based Classification Authors: Gökdeniz Ersoy, Mehmet Alper Tatar, Eray Tonbul and Serap Kırbız Presenter: Serap Kırbız, MEF University, Turkey Abstract: Driver drowsiness is a major cause of traffic ac- cidents worldwide, posing a serious threat to public safety. Vision-based driver monitoring systems often rely on fixed Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) thresholds; however, such fixed values frequently fail to generalize across individuals due to variations in facial structure, illumination, and driving conditions. This paper proposes a personalized driver drowsiness detection system that monitors eyelid movements, head position, and yawning behavior in real time and provides warnings when

	signs of fatigue are detected. The system employs driver-specific EAR and MAR thresholds, calibrated before driv- ing, to improve classical metric-based detection. In addition, deep learning–based Convolutional Neural Network (CNN) models are integrated to enhance accuracy in challenging scenarios. The system is evaluated using publicly available datasets as well as a custom dataset collected under diverse lighting conditions, head poses, and user characteristics. Experimental results show that personalized thresholding improves detection accuracy by 2–3% compared to fixed thresholds, while CNN-based classification achieves 99.1% accuracy for eye state detection and 98.8% for yawning detection, demonstrating the effectiveness of combining classical metrics with deep learning for robust real-time driver monitoring.

Online Session 4.1

Circuits, Signal Processing & Communication Systems

- **Session Chair**: Ioana-Gabriela Sirbu, University of Craiova, Romania
- **Time**: 13:00-15:30, April 29
- **Online Room**: Room B (894 4933 0640)
- **Papers**: B3158 B1021 B3099 B3103 B3161 B4179 B2065 B2082 B2085 B3133

B3158 13:00-13:15	Design and Integrated Electromagnetic and Circuit Simulation of a Resonant Wireless Power Transfer System for Unmanned Aerial Vehicles Authors: Burak Yoruk, Ali Agcal, Fatma Keskin Arabul Presenter: Burak Yörük, Yildiz Technical University, Turkey Abstract: The mission duration of Unmanned Aerial Vehicles (UAVs) is limited by their onboard energy capacity, which restricts their operational capabilities. To address this limitation, this study investigates a wireless power transfer (WPT) system based on resonant magnetic coupling. A system consisting of square transmitter and receiver coils is considered, and the operating frequency is selected as 140 kHz based on the system dimensions and the targeted power level. The system performance is also analyzed over a range of operating frequencies. The variation of mutual inductance with respect to the distance between the coils is examined. Electromagnetic field and magnetic flux distributions are obtained using the ANSYS Electromagnetics environment, and mutual inductance values are calculated through flux linkage-based simulations. These parameters are transferred to the ANSYS Circuit environment to evaluate the circuit-level performance of the system in terms of power transfer, current characteristics, and efficiency. This study presents an integrated framework that jointly evaluates electromagnetic field behavior, circuit-level responses, and frequency-dependent efficiency in UAV-oriented resonant WPT systems.
B1021 13:15-13:30	Optimal and analysis of annular ring microstrip antenna using GA Authors: Chemachema Karima; Ikhlef Ismahene Presenter: Chemachema Karima, University of Constantine 1, Algeria Abstract: In this work, structure of Annular Ring Microstrip Antenna (ARMSA) is studied. The S11, Zin and VSWR, parameters of an Annular patch Microstrip antenna are investigated and optimizated. Its structure has been optimized using a very simple and appropriate Genetic Algorithm (GA) tool. The calculation of the structural parameters using the cavity model analysis. GA optimizes the structure of reference antenna for the optimum response in terms of Reflection coefficient, input impedance and voltage standing wave ratio. The optimized antenna exhibits excellent characteristics in terms of these performance parameters as compared to the reference antenna. The optimization is performed by varying the feed location, the inner and outer radius of annular Ring. The impedance and return loss characteristics of annular patch antenna are examined and compared. It is able to achieve a return loss less than -43 dB and VSWR < 2.

B3099 13:30-13:45	Development of a Smart Textile-based 2.4 GHz DGS-Antenna for Breast Cancer Diagnosis Authors: Israa M. F. A. Alhammoodi, Mehmet Ali Dalgıç, Diaa E. Fawzy, A. M. M. A. Allam and Berkay Burak Toker Presenter: Israa Alhammoodi and Diaa E. Fawz, Izmir University of Economics Izmir, Turkey Abstract: In this study, we have developed a wearable system for breast health monitoring and cancer diagnosis. The system's development involved the integration of textile-based electronics and microwave technology, resulting in a cost-effective and noninvasive solution. The system is composed of two analogous textile-based Defected Ground Structure (DGS) patch antennas. The antennas demonstrate sufficient flexibility to adapt to the shape of the human body, thereby ensuring long-term user comfort. The antenna is initially optimized to resonate at Industrial, Scientific, and Medical (ISM) 2.4 GHz band in free space. A three-layered breast model populated with artificial tumors of varying dimensions has been developed, thus enabling the observation of the antenna's response through the measurement of the S11 parameter. The obtained results are encouraging. A discernible variation in the resonance frequency and in the S11 values is evident in the presence of tumors, suggesting a good potential for detecting changes in tissue associated with cancer. Subsequent to the fabrication of the antenna, real-world testing is conducted using a network analyzer and physical breast phantom models. The experimental findings exhibited a high degree of concurrence with the simulations, thereby substantiating the antenna's capacity to discern anomalies through alterations in the resonance frequency and in the S11 parameter. This approach is consistent with the overarching objective of facilitating early, comfortable, and routine health monitoring through the utilization of smart clothing.
B3103 13:45-14:00	Development of a DGS-based ultra-wide band antenna array for LTE, WiFi, and 5G beam steering applications Authors: Irem Ozkan, Mehmet Can Ergun, A. M. M. A. Allam and Diaa E. Fawzy Presenter: Irem Özkan and Diaa E. Fawzy, Izmir University of Economics Izmir, Turkey Abstract: This paper presents the design and simulation of a novel ultra-wideband microstrip antenna by employing a logobased Defected Ground Structure (DGS). The DGS is achieved by optimizing the ground plane of the antenna array in accordance with the logo of the ˙Izmir University of Economics. This modification is implemented to generate a distinctive, irregular, and asymmetrical defect within the ground plane, thereby inducing an uneven surface current distribution. Consequently, the DGS has demonstrated a substantial enhancement in impedance bandwidth by a factor of approximately 100 compared to a standard microstrip antenna with a solid ground plane. The results of the simulation demonstrate optimal impedance matching over a broad spectrum of frequencies of about 4 GHz, covering the LTE, 5G mid-band, and Wi-Fi bands. The FR-4 substrate with a relative permittivity of $\epsilon r = 4.3$ is employed in this study; the antenna is developed through full-wave electromagnetic simulations within the CST Suite tool. Subsequently, a fourelement array is then constructed and

	optimized for the same frequency range, resulting in an enhancement in the overall gain. The obtained bandwidth of the array is about 1.8 GHz, which is highly suitable candidate for beam scanning applications.
B3161 14:00-14:15	Inkjet-Printed CPW-Fed Meandered Inverted-F Triband Antenna on PET for Sub-GHz IoT ISM and 5/6 GHz Wi-Fi Applications Authors: Arshad Hassan, Ghiayas Tahir, Shawkat Ali, Arshad Khan and Amine Bermak Presenter: Arshad Hassan, Hamad Bin Khalifa University, Qatar Abstract: The fifth and sixth generation wireless communication systems and internet of things have created an urgent demand for cost-effective and multiband connectivity devices operating across multiple frequency standards. In this paper, we present a new design based on a coplanar waveguide and a modified inverted-F configuration with specific meandering to achieve multiband resonances. The proposed antenna fabricated on a cost effective flexible and transparent polyethylene terephthalate substrate using inkjet printing technology with functional silver nanoparticle ink, demonstrating significant advantages over conventional printed circuit board manufacturing. The proposed antenna achieves multiband operation covering sub-GHz IoT/ISM (0.7793–1.0109 GHz), a mid-band centered at 2.151 GHz (2.0320–2.2709 GHz), and 5/6 GHz Wi-Fi portions (5.3526–6.7900 GHz) with excellent performance characteristics including a simulation peak gain of 16.21 dBi and fractional bandwidths of 25.9%, 11.1%, and 23.7% respectively. The proposed antenna performance is comprehensively evaluated via electromagnetic simulations in high frequency structure simulator and experimental validated via vector network analyzer and an anechoic chamber measurement. The measured results show that the prototype is effectively working across all three operating bands with excellent radiation characteristics suitable for diverse wireless communication applications including IoT sensor networks, wireless local area networks, and next generation 5G systems.
B4179 14:15-14:30	Design and Analysis of The Performance of Downstream Next-Generation PON2-RF-QAM System for Long-Range Networks Authors: Dhuha Abdulkareem Hameed; Wasan Kadhim Saad Presenter: Dhuha Abdulkareem Hameed, Al-Furat Al-Awsat Technical University (ATU), Iraq Abstract: Abstract– The demand for 5G and digital transformation has created a reality that requires high speeds and instant responsiveness, which is why we have integrated next generation passive optical network 2 and radio over fiber technologies to combine the capacity of fiber optics with the flexibility of wireless connectivity. The major problem is the difficulty of preserving signal stability at high frequencies (24 GHz), where fiber dispersion and noise cause a remarkable decay in performance over long distances. In this paper, we analyzed the system performance in practical terms by evaluating different modulation levels ranging from 16 to 256-QAM. The simulation results revealed that the use of DCF techniques was essential to secure data transmission at a rate of 40 Gbps over a distance of 50 km, with BER and EVM values remaining within the required limits. These results confirm the feasibility of adopting this design as a practical framework for developing highly efficient long-range future networks.

B2065 14:30-14:45	Impact of Hardware Impairments in Multi-Cell Massive MIMO for 5G Networks Authors: Raed Daraghma Presenter: RAED DARAGHMA, Palestine Technical University − Kadoorie (PTUK), Palestine Abstract: Massive MIMO is a possible technology to improve spectral efficiency (SE) of cellular networks. It involves constructing antenna arrays with hundreds or thousands of active elements at base stations and using coherent transceiver processing. In this research, we study and calculate the influence of hardware impairments on the DL error floors in the channel estimator, mismatched estimator at different types such as LMMSE and NMSE. This paper also investigates the joint impact of non-linear hardware impairments at the base station (BS) and user equipment's (UEs) on the downlink performance of single-cell massive MIMO (multiple-input multiple-output) with a uniformly distributed nominal angle in a Gaussian angular distribution environment. We compare the suggested approaches to cutting-edge linear minimum mean squared error (LMMSE) and minimal mean squared error (MMSE) estimators.
B2082 14:45-15:00	Secrecy Performance of RIS-Enabled NOMA Networks with Non-Ideal Hardware and Imperfect CSI Authors: Merve Uçar-Gül, Mustafa Namdar, Ozgur Ergul Presenter: Merve UÇAR-GÜL, Gazi University, Turkey Abstract: This paper examines the secrecy performance of a reconfigurable intelligent surface (RIS)-assisted non-orthogonal multiple access (NOMA) network by explicitly incorporating distortions caused by hardware impairments (HWI) and residual interference due to channel estimation errors (CEE) into the system model. Focusing on the far user (FU), a closed-form expression for the secrecy outage probability (SOP) is derived in the presence of HWI and CEE. The resulting analytical framework is then employed to investigate the impact of key system parameters, such as the number of RIS reflecting elements, target data rate, and level of impairment. Furthermore, the individual effects of hardware-induced distortions and channel uncertainty on secrecy performance are analysed in detail. Monte Carlo simulations are presented to validate the analytical results and to demonstrate the accuracy of the derived expressions. The findings indicate that practical impairments impose inherent limitations on secrecy performance, while increasing the number of RIS reflecting elements can effectively alleviate their adverse impact, underscoring the relevance of robust and practical RIS-assisted NOMA system architectures.
B2085 15:00-15:15	Privacy-and Mobility-Aware Joint Resource Allocation and Mode Selection in D2D-Enabled 6G Networks using Federated-Double Deep Q Learning Authors: Hafiz Muhammad Fahad Noman, Effariza Hanafi, Kaharudin Dimyati, Kamarul Ariffin Noordin Presenter: Hafiz Muhammad Fahad Noman, Universiti Malaya, Malaysia Abstract: Mobility management and energy-efficient resource allocation are key enablers for device-to-device (D2D)-empowered sixth-generation (6G) wireless networks. However, severe co-channel interference between cellular users (CUs) and D2D users (DUs) in mobility-aware heterogeneous 6G

	networks may impact Quality of Service (QoS) and reduce overall system performance. To address this, a Federated Double Deep Q-Learning (DDQN)-based joint resource allocation and mode selection (F-JRAMS) scheme is proposed for dynamic switching between D2D and cellular modes. A zone-based mobility model is considered to determine the spatial correlations and dynamic user movements. Furthermore, a Maximum Mean Discrepancy (MMD)-based federated learning regularization is employed to mitigate the impact of non-independent and identically distributed (IID) data distributions across local agents and users' privacy preservation. Simulation results depict that the proposed F-JRAMS framework achieves higher spectral energy efficiency (SEE) and consistent QoS compared with the existing schemes under mobility and heterogeneous network scenarios.
B3133 15:15-15:30	A Multi-Band "Hand of God" Fractal Antenna for Compact Wide-Range RF Applications Using Dielectric Thickness Optimization Authors: Mona K. El Abbasi, Mervat Madi and Karim Y. Kabalan Presenter: Mona El Abbasi, American University of Beirut, United Arab Emirates Abstract: This work presents a compact multi-band fractal antenna inspired by a bio-geometric Hand-of-God profile. The design consists of five elongated branches with integrated slots, enabling the excitation of multiple resonant modes. A comprehensive parametric study is conducted to examine the influence of substrate thickness on the antenna's electromagnetic performance, employing Rogers RO4003 laminates with thicknesses of 0.203 mm, 0.406 mm, 0.588 mm, 0.8128 mm, and 1.524 mm. The investigation highlights how dielectric thickness affects impedance matching, resonance distribution, and bandwidth behavior. Simulation results confirm wideband operation across 4–32 GHz, with resonances grouped within the sub-6 GHz, X-, Ku-, K-, and Ka-band ranges. Findings reveal that substrate thickness significantly impacts resonance depth, bandwidth expansion, and modal spacing. With its compact geometry, multi-resonant characteristics, and extensive frequency coverage, the proposed antenna is well suited for applications in multi-mode radar, broadband imaging, gesture recognition, and next-generation wideband microwave and millimeter-wave communication systems.

Online Session 5.1

Renewable Energy, Smart Grids & Smart Buildings

- **Session Chair:** Mohd Fadzil Abdul Kadir, Universiti Sultan Zainal Abidin, UniSZA, Malaysia
- **Time**: 13:00-15:15, April 29
- **Online Room**: Room C (864 5762 2005)
- **Papers**: B1018 B1032 B2072 B2090 B3101 B3121 B3159 B3100 B3108

B1018 13:00-13:15	The Impact of Thermal Profiling on Electronic Board Manufacturing Authors: Berkay Can ŞAFAK, Sezen ZEREN, Kaan ULUSOY, Emre Ethem BİLGEER Presenter: Sezen ZEREN, Sülayman Demirel Üniversitesi, Turkey Abstract: This study investigates the impact of thermal profile optimization on solder joint quality in a surface mount printed board manufacturing process. The existing reflow profile, applied using an eight-zone reflow oven operating under nitrogen atmosphere, was analyzed using the Process Window Index methodology. Initial measurements revealed a Process Window Index value significantly exceeding recommended process limits, indicating risks such as insufficient wetting, cold solder joints, and thermal stress. Based on solder paste specifications and through systematic adjustments of zone temperatures and conveyor speed, two optimization experiments were conducted following the baseline condition. The first optimization substantially reduced the Process Window Index, and a subsequent refinement yielded an even lower value. For the 2-layer Printed Circuit Board, this refined profile was selected as the most efficient configuration. Experimental results confirm that thermal optimization significantly improves solder reliability and process stability.
B1032 13:15-13:30	Carbon-Oriented Operational Optimisation of a Chp-Abs–Hp–Dh System for a Data Centre Authors: Okan Kondul, Recep Yumurtaci, Bedri Kekezoglu, Mehmet Bayrak Presenter: Okan Kondul, Yildiz Technical University, Turkey Abstract: Data centers are among the most energy-intensive building types due to their continuous IT loads and strict cooling requirements. In this study, a simplified linear optimization model is developed to minimize the annual net CO_2 emissions of a data center supplied by the electrical grid and a gas-engine combined cooling, heating and power (CCHP) system. The configuration includes a 2.5 MW CHP unit, an absorption chiller, a mechanical chiller, a heat pump and an interface to a district-heating network. The model is implemented in Pyomo and solved with hourly resolution for one full year using ERA5 weather data for Istanbul, 1.6 MW IT and 0.45 MW non-IT loads, and official Turkish electricity and natural-gas prices. While the optimization objective is purely environmental, annual electrical PUE and operating cost are calculated ex post to compare different operating strategies. Three scenarios are analyzed: grid-only baseline, CHP

	with absorption cooling, and a full configuration including heat pump and district-heating export. Results show that CHP with absorption cooling can reduce CO_2 emissions from 13,144.97 tCO_2 in the baseline to 8,541.08 tCO_2 ($\approx$ 35 % reduction) and annual cost from 70.96 M TL to 49.61 M TL ($\approx$ 30 % reduction), with an annual PUE of 1.354. The full configuration further decreases CO_2 emissions to 7,985.31 tCO_2 ($\approx$ 39 % reduction) and enables 6.25 GWh_{th}/year of district-heating export, though with slightly higher PUE (1.446) and operating cost (53.47 M TL). The study highlights that carbon-optimal operation does not necessarily coincide with minimum PUE or minimum cost, underlining the importance of multi-metric evaluation in data centre energy studies. Keywords—data centre, CCHP, CHP, heat pump, district heating, CO_2 optimisation, PUE.
B2072 13:30-13:45	System-Level Modelling of a Hydrogen Internal Combustion Engine with Balance of Plant Components: Performance and Emissions Analysis Authors: Cemil Şen, Emir Oğuz Presenter: Cemil Şen, AVL Turkey Research and Engineering, Turkey Abstract: The rising global energy demand and its environmental impact necessitate a transition from fossil fuels to sustainable alternatives. Hydrogen, with its clean combustion properties, is a promising option for achieving near-zero emissions in the automotive sector. Hydrogen-fueled internal combustion engines (H2ICEs) can be realized with relatively minor modifications to conventional engines while maintaining competitive performance. This paper develops a comprehensive modelling framework of an H2ICE, including key balance of plant (BoP) components, to investigate system behaviour under various operating conditions. The analyses were conducted using AVL Cruise.M, a well-established platform for thermodynamic, chemical, and fluid-dynamic simulations. Simulation studies used to assess performance and emissions while confirming model validation with accuracy. Keywords: Hydrogen, internal combustion engine, balance of plant, modelling, simulation
B2090 13:45-14:00	Enhancing Power Electronics Reliability by Weather Condition Based Hybrid Filtering in V2G with Integrated Renewables Authors: Berk Aşçıoğlu, Nazif Hakan Yeniay, Canraş Batunlu Presenter: Berk Aşçıoğlu, AVL Turkey Research and Engineering, Turkey Abstract: Vehicle to grid (V2G) is a promising solution to support the grid energy. It allows the electric vehicles (EVs) to provide their battery energy into the grid during peak load demand. The batteries can also get charged when the load demand is low with bidirectional characteristic of the technology. It also helps to utilize renewable energy sources coupled with grid. The weather condition based variations and lack of the demand power can be compensated with the presence of the batteries. Yet, many concerns about the V2G still remaining such as battery degradation, reliability and capacity loss. The power electronic converters are responsible for controlling and processing the flow of electrical energy between within grid. Semiconductor devices such as Insulated Gate Bipolar Transistors (IGBTs), are used as switching elements in these devices to control and manage timing and shaping of the energy flow with possible minimal loss. However, their lifetime is highly depended on the thermal variations. In this work, the reliability of the IGBTs are investigated under different filtering conditions of a

	V2G system based electrical grid. A proposed hybrid filter showed the best performance as it caused 45% less lifetime consumption compared to the conventional hybrid filtering.
B3101 14:00-14:15	Challenges and Technologies of Energy Storage Systems Integration into the Grid: A Short Review Authors: Hajar Bellamdaouar and Mohammed Ouassaid Presenter: Hajar Bellamdaouar, Mohammed V University in Rabat, Morocco Abstract: The rapid replacement of synchronous generation by inverter-based renewable energy sources has significantly reduced system inertia. Unlike existing reviews that treat storage technologies or control strategies in isolation, this paper offers a unified roadmap of integrating energy storage into modern powe systems showing how ESS can help restore frequency resilience and maintain stability in modern power systems over transmission, distribution, and microgrid levels. Storage technologies are divided based on their physical characteristics, distinguishing between power-oriented systems for instantaneous stability and energy-oriented systems for long-duration bulk support. Central importance is given to the transition from grid-following to grid-forming control and on the role of synthetic inertia in mitigating rapid frequency excursions. The essential international standards that govern the safe and interoperable deployment of ESS are examined to identify current technical limitations and emerging design trends. The analysis concludes that while storage capacity is essential for decarbonization, the ultimate survival of the low-inertia grid depends on the sophisticated coordination of fasrt acting control paradigms and diverse storage architectures.
B3121 14:15-14:30	Development of a Single-Phase Active Power Filter with Reconfiguration Capability in the Power Supply Authors: Luis Bolivar Landeta Guerrero, Carlos Ivan Quinatoa Caiza and Secundino Marrero Ramirez Presenter: Luis Bolivar Landeta Guerrero, Facultad de Ingenier´ıa y Ciencias Aplicadas Universidad Tecnica del Cotopaxi Latacunga, Ecuador Abstract: This paper presents the design and simulation of a single-phase shunt active power filter (SPAF) aimed at reducing current harmonic distortion in the IEEE 13-bus test system, specifically at node 634, phase C. The proposed approach re places the conventional DC-link source with a cascaded multicell converter (CMC). The SPAF operates under hysteresis current control at a voltage of 800 Vac, allowing accurate reference current tracking and a fast dynamic response to load variations. To ensure service continuity and reliability, an interleaved decen tralized iterative control scheme is implemented to coordinate the CMCcarrier signals and monitor the phase displacement among cells. Validation is carried out through MATLAB/Simulink simula tions under both normal and fault conditions, including scenarios involving the loss of one converter cell, where the CMC reestab lishes operation at 800 Vdc within 20 ms. The obtained results demonstrate that the system maintains proper operation under cell-fault conditions and provides effective harmonic mitigation, reducing the total harmonic distortion (THD) from 44.06% to 0.81%. In conclusion, the proposed configuration enhances power quality, strengthens operational robustness, and represents a reliable and scalable alternative for harmonic compensation in distribution networks.

B3159 14:30-14:45	Improving Grid Distortion Factor By Weather Condition Based Filtering in Two and Three Level Inverters for V2Gs with Integrated Renewables Authors: Berk Aşçıoğlu, Nazif Hakan Yeniay, Canraş Batunlu Presenter: Berk Aşçıoğlu, AVL Turkey Research and Engineering Istanbul, Turkey Abstract: Vehicle to grid (V2G) facilitates the electric vehicles (EVs) to supply grid by providing bidirectional energy flow between EVs and the grid. In these systems, energy can be fed to the grid, or it can be drawn from the grid according to the time of the day. Weather condition-based variations and required excess demanded power can be compensated with the integration of the batteries. The grid coupling of the EVs and possible renewable energy integration is provided by an inverter through a DC link common coupling point. Two and three level inverters are responsible of power and voltage coupling in this regard. Different filtering strategies can be used for smoothing the output voltage of the rectangular based output of the inverters. In this work, a predictive hybrid filtering method is proposed aiming to decrease Total Harmonic Distortion (THD) level with respect to the weather condition-based variations. The average current THD, compared to the conventional active – passive mode filtering, has improved by 25% and 22% for two and three level inverters, respectively. On the other hand, the improvement for the average voltage THD is 17 % for two level and 14% for the three level inverter cases.
B3100 14:45-15:00	Techno-Economic Feasibility of Green Hydrogen as a Reducing Agent in Steel Manufacturing Authors: Gaydaa Alzohbi Presenter: Gaydaa Alzohbi, Prince Mohammad Bin Fahd, Saudi Arabia University, Saudi Arabia Abstract: This paper aims mainly to evaluate the techno-economic feasibility of the transition from traditional, coal, heavy blast furnace routes to green hydrogen, based direct reduction (H2-DRI) combined with Electric Arc Furnaces (EAF). The headline is that this route allows the reduction of CO2 emissions by more than 90%, however, its immediate use is limited by a "green premium" that necessitates the cost of hydrogen supply to be below $1.40/kg for the price to be competitive with the current technologies. Besides, the research discovers two important secondary points: firstly, the absence of carbon in the iron produced by H2 considerably lowers the metallurgical EAF operational efficiency; secondly, the estimated shortfall of more than 100 million tons of high, quality (DR, grade) iron ore by 2031 poses a significant supply chain bottleneck. The work ends with a global scale decision depending on aggressive carbon pricing and regional iron production turning to renewable, rich areas.
B3108 15:00-15:15	Architectural Design Challenges for Smart Buildings: Integrating Hydrogen Fuel Cells as Secondary Backup Power Authors: Gaydaa Alzohbi Presenter: Gaydaa Alzohbi, Prince Mohammad Bin Fahd, Saudi Arabia University, Saudi Arabia Abstract: As the global transition to a net-zero emission economy quickens, smart buildings are progressively changing from being passive consumers

	towards becoming active players in the energy ecosystem. Lithium-ion batteries (LIBs) account for most short-term energy storage, however, they are limited in long-duration backup and seasonal energy shifting. This paper considers the idea of incorporating Hydrogen Fuel Cells (HFCs) as a clean, high-energy-density secondary backup power source for contemporary smart buildings. The research points out the main architectural and technical obstacles to the use of HFCs, such as the space required for on-site hydrogen storage, the integration with the existing Building Energy Management Systems (BEMS), and the logic of the automated switching.

Online Session 4.2

Circuits, Signal Processing & Communication Systems

- **Session Chair**: Canras Batunlu, Middle East Technical University Northern Cyprus Campus, Turkey
- **Time**: 16:00-18:15, April 29
- **Online Room**: Room A (872 1281 1832)
- **Papers**: B2052 B2089 B3107 B3116 B4198 B3139 B3141 B4192 B4201

B2052 16:00-16:15	Signal-Quality-Driven Hybrid ECG Denoising Using Optimized Wavelet and Variational Mode Decomposition Authors: Nema Salem, Alaa Aldybous, Mawa Hijji Presenter: Alaa Aldybous, and Mawa Hijji, Effat University, Saudi Arabia Abstract: Electrocardiogram (ECG) signals are highly susceptible to non-stationary noise, which can compromise diagnostic accuracy. Variational Mode Decomposition (VMD) offers high-fidelity denoising but is computationally intensive, whereas the Dis crete Wavelet Transform (DWT) provides low-latency processing but may distort the QRS morphology under severe noise conditions. This paper presents an adaptive hybrid ECG denoising framework that inte grates optimized DWT and VMD parameters within a signal-quality-driven mode-switching strategy. A safety-aware decision mechanism selects between a low-latency Fast Mode that utilizes the optimized DWT and a high-fidelity Rescue Mode that employs optimized VMD, thereby balancing efficiency and signal integrity in real-time. Validation on the MIT BIH Arrhythmia Database (N = 48) achieves an average output Signal to Noise Ratio (SNR) of 12.36 dB, a 7.35 dB improvement, and a structural similarity index (SSIM) exceeding 90%. The DWT mode is selected for 27% of records, reducing execution time from 1367.25 ms to 0.87 ms and yielding a 1562× computational speedup, demonstrating suitability for scalable real-time ECG monitoring.
B2089 16:15-16:30	An Experimental Comparison of the Trueness of the Blob Detectors Authors: Yağmur TAZE, İbrahim Cem BAYKAL Presenter: Yağmur TAZE, Adana Alparslan Türkeş Science and Technology University, Turkey Abstract: Blob detection is one of the important methods used in the field of image processing to extract meaningful information from images. It is used in many important fields such as medical imaging, object tracking and astronomy. The objective of this study is not to evaluate the key point detection, but to evaluate the actual round blob detection performance of the blob detectors for general purpose computer vision applications. As the first step, the blob detector algorithms that have already been implemented on various platforms are tested using a small but diverse data set to eliminate the worst ones. Then, the remaining contenders are implemented from scratch, in order to adjust their implementation details and parameters, so that, their accuracies score as high as possible on the first dataset. Finally, in

	order to measure the accuracy and the trueness of these implementations under difficult conditions, they are tested on artificially created datasets that get increasingly more challenging. Blob detectors can show varying accuracies in aspects such as sharp-ness, contrast, and noise of images. Results show that, if the image quality is high, the simple grayscale blob detector has the highest accuracy. If the im-age has blur or noise, then the MSER prevails, while the Difference of Gaussians (DoG) has the highest trueness.
B3107 16:30-16:45	Dimensionality Reduction and Sensor Fusion for Repetition-Aware sEMG Gesture Recognition Authors: Burak AĞGÜL, Kaan ARIK Presenter: Kaan ARIK, Sakarya University of Applied Sciences, Turkey Abstract: Surface electromyography (sEMG) is a non-invasive sensing modality widely used for intuitive prosthetic and assistive device control. However, multi-class gesture recognition remains challenging due to inter-class similarity, subject variability, and the high dimensionality of multi-sensor signals. This study presents a systematic gesture classification pipeline based on windowed segmentation, time-domain sEMG features, dimensionality reduction, and optional inertial sensor fusion. Using a fixed 200 ms window and 50 ms stride, we define a movement-only multi-class task by excluding rest segments to reduce label ambiguity and class imbalance. We compare PCA and LDA for dimensionality reduction and benchmark RBF-SVM and Random Forest classifiers. We also examine the effect of sensor fusion (sEMG only vs. sEMG+accelerometer) under a repetition-aware group split for reliable evaluation. Results show that dimensionality reduction and sensor fusion improve macro-F1 performance, while class-wise error analysis highlights a limited set of consistently confusable gesture pairs. The proposed pipeline provides a compact and effective baseline for robust myoelectric gesture recognition.
B3116 16:45-17:00	Enhanced Recursive Adaptive Inversion Algorithm Authors: Mostafa Rashdan and Mohammad Salman Presenter: Mohammad Salman, American University of the Middle East, Kuwait Abstract: The recursive inverse (RI) adaptive filtering technique has demonstrated superior performance characteristics compared to various established adaptive filtering methods. A primary challenge facing the RI technique is its dependence on time-varying step-size parameters, which limits its effectiveness in situations involving substantial eigenvalue spread within the covariance matrix. This work presents an enhanced variant of the RI technique. Our proposed methodology employs a nonlinear step-size mechanism designed to mitigate the influence of covariance matrix eigenvalue spread on RI technique performance. Although this nonlinear step-size approach introduces additional computational burden compared to the standard RI technique, the overall complexity remains on par with that of the RLS method. Through implementation of this nonlinear step-size strategy, our proposed technique achieves superior performance in scenarios characterized by large eigenvalue spread within the covariance matrix, effectively resolving the primary constraint of the traditional RI approach. Experimental validation demonstrates that our proposed technique

	outperforms the traditional RI method and achieves performance levels equivalent to or exceeding those of the RLS technique.
B4198 17:00-17:15	EEG-Based Attention State Classification Using Band-Power and Ratio Features Authors: Samet ORAN and Esen YILDIRIM Presenter: Samet ORAN, Adana Alparslan Türkeş Science and Technology University, Turkey Abstract: In challenging operational environments, attention can wander over time, and even small distractions can lead to significant performance losses. Sustained attention monitoring is crucial for mitigating risks by detecting performance degradation early in safety-critical tasks. This study performs a three-class (focused, unfocused, and drowsy) attention state classification on an open-access train simulator EEG dataset. Channel-based power features for the theta, alpha, and beta bands, together with band-ratio features, were extracted from EEG signals for classification. Subject-wise and LOSO validations were performed using k-NN, RF, and SVM classifiers. Among the evaluated classifiers, SVM achieved the best average performance, reaching 91.93% accuracy and 91.94% macro-F1 in the subject-wise evaluation. Furthermore, feature importance analysis indicates that the information contributing to the classification is predominantly concentrated within the theta frequency band and localized at the channel level, particularly in the fronto-central and temporal regions.
B3139 17:15-17:30	Speed Optimizations and Corrections to AGAST Authors: İbrahim Cem BAYKAL, Yağmur TAZE Presenter: Yağmur TAZE, Adana Alparslan Türkeş Science and Technology University Abstract: The AGAST (Adaptive and Generic Corner Detection Based on the Accelerated Segment Test) corner detector algorithm is among the fastest corner detectors ever published in the literature. Because of its speed, it has already been used in thousands of Robot Vision applications causing AGAST and its predecessor FAST to be cited thousands of times. Software implementations of these algorithms employ machine learning to come up with the fastest decision tree to implement these algorithms. This article demonstrates a different approach to AGAST software implementation that exploits the hardware architectures of modern processors. Experiments show that this approach speeds up AGAST5×8 by %34. This article also points out a few mistakes in the AGAST5×8 algorithm and corrects them. The resultant implementation is called the FAGAST and is already included in a Robot Vision library called the I-See-Bytes.
B3141 17:30-17:45	Evaluating Class Imbalance Handling Methods for Multi-Class IoT Intrusion Detection: A Comparative Study on the CIC-IoT 2023 Dataset Authors: Sheikh Muhammed Tadeeb, Figen Özen Presenter: Sheikh Muhammed Tadeeb, Yildiz Technical University, Turkey Abstract: With growing deployments of IoT devices across various sectors, the attack ratio has significantly increased, making intrusion detection systems (IDS) essential. However, almost all the major IoT network traffic

	datasets have severe class imbalance, where rare but critical attack types such as malware and brute force are vastly outnumbered by dominant classes like DDoS. In order to balance the datasets, majority of the studies use SMOTE without considering alternative approaches. This paper presents a systematic comparative evaluation of four class imbalance handling methods, namely Baseline (no balancing), SMOTE, Cost-Sensitive Learning, and Threshold Optimization on the CIC-IoT 2023 dataset using Random Forest and LightGBM classifiers. Experiments are conducted on the coarse-grained 9 class multi-class classification task with 19 million unique network flow records. Results demonstrate that Cost-Sensitive Learning achieves the highest minority class recall improvements, increasing malware detection from 1.87% to 51.94% with LightGBM, a 2,678% relative improvement, while requiring zero additional preprocessing time or memory overhead. SMOTE, by contrast, provides marginal improvements and cannot scale to the full dataset without subsampling. Threshold Optimization achieves the best overall Macro F1 balance. These findings offer practical guidance for IoT security practitioners in selecting appropriate imbalance handling strategies.
B4192 17:45-18:00	Optimal Component Value Selection for Second-Order State Variable Active Filter Using Discrete Sine-Cosine Algorithm Authors: Mehmet Fatih Demiral, Gürkan Bilgin Presenter: Mehmet Fatih Demiral, Burdur Mehmet Akif Ersoy University Burdur, Turkey Abstract: The second-order State Variable low-pass filter (SVF), an analog active filter, is of critical importance in many fields, such as medical electronics and audio systems, due to its multifunctionality, stability, and independently adjustable parameters. The practical efficiency of this filter configuration depends on selecting appropriate passive component values from standard production series. However, the manual selection of optimum component values poses a significant engineering challenge. Accordingly, evolutionary and heuristic computational methods are employed to minimize the total design error without compromising performance characteristics. In this study, the Discrete Sine-Cosine Algorithm (DSCA) was utilized for the optimal design of a second-order SVF circuit. The focus was on minimizing the total design error, and the algorithm successfully optimized the component values using the commercially available E12 series. Simulation results demonstrated the efficiency of the DSCA method in minimizing error even under E12 constraints. Additionally, the filter's amplitude response has achieved maximum flatness within the passband, and a cutoff frequency value so close to the ideal has been measured. In comparison to traditional design methods documented in the literature, the proposed DSCA method exhibits a higher degree of accuracy.
B4201 18:00-18:15	Fairness-Aware Energy-Efficient Two-Way Relaying with Nonlinear WPT: Fixed and Mobile Relays Authors: Rami Zaino, Mohamed Hassan and Teong Chee Chuah Presenter: Rami Zaino, American University of Sharjah, United Arab Emirates Abstract: This paper investigates fairness-aware energy efficiency in wirelessly powered two-way relay channels (TWRCs) with a realistic

	nonlinear energy-harvesting (EH) model. Building on an existing SWIPT framework with fixed and mobile relays, we reuse the optimal rate-region solvers and reinterpret their outputs through two metrics: relay energy efficiency (bits/Joule) and a directional fairness index defined as the ratio of the weaker to the stronger user rates. For the fixed relay, Monte Carlo simulations show that energy efficiency is maximized at a moderately balanced priority weight, whereas perfect fairness is achieved when both users are equally prioritized. For the mobile relay, two representative trajectories are examined. The results reveal that relay mobility can substantially enhance energy efficiency compared with the fixed case, while the fairness behavior as a function of the priority weight remains essentially unchanged across trajectories. The resulting energy efficiency– fairness curves provide compact design insights that complement prior rate-region analyses of nonlinear-EH TWRCs.

Online Session 5.2

Renewable Energy, Smart Grids & Smart Buildings

- **Session Chair**: Murad Al-Omary, German Jordanian University, Jordan
- **Time**: 16:00-18:20, April 29
- **Online Room:** Room B (894 4933 0640)
- **Papers**: **Invited Speech** B4211 A25 B3109 B4181 B3128 B4218 B4219 B1023

Invited Speech
16:00-16:20

Dr. Siti Nabila Aidit
Universiti Malaya, Malaysia

Next-Generation Wearable Electronics: Advancing Healthcare through Flexible and Printable Technologies

Abstract: The transition toward personalized, continuous healthcare requires a new generation of electronic systems that are not only high-performing but also mechanically flexible and cost-effective to produce. This presentation explores recent advancements in the field of printable electronics, focusing on the synergy between innovative nanomaterials and scalable additive manufacturing techniques. The research examines the development of various sensing platforms including biochemical, thermal, and physiological monitors. Central to this work is the application of low-cost printing methods, such as dispense and screen printing, to create high-resolution electrode arrays on flexible substrates. By functionalizing these platforms with advanced nanohybrids and biopolymer-based electrolytes, the study demonstrates significant improvements in sensitivity, response time, and mechanical durability. The discussion highlights how these technological pillars, material innovation and rapid fabrication enable the creation of robust, degradable, and stretchable wearable devices. These advancements provide a foundation for non-invasive, real-time diagnostic tools that bridge the gap between traditional clinical settings and proactive mobile healthcare.

B4211 16:20-16:35	An Augmented P&O Algorithm for MPPT in Solar-Scavenging Applications Authors: Murad Al-Omary, Abdel Rahman Abuwardeh, Leen Ayyad, and Rakan Alqaisi Presenter: Murad Al-Omary, German Jordanian University, Jordan Abstract: Modern solar-scavenging devices are no longer free of the Maximum Power Point Tracking (MPPT) units. Such units compute the

	maximum power point (MPP) and deliver it to the converter, aiming to achieve the highest benefit of the exploitable solar energy and shorter payback periods. Simple classical algorithms are still preferred for the small-scale devices over the machine-learning-based ones. This paper presents an augmented P&O algorithm and assesses its performance through comparison with the three other simple classical algorithms. This Augmented P&O algorithm uses both normal P&O and TPWC algorithms together in one algorithm. The results showed that the augmented P&O algorithm has an average error of 2.31% over a one-week simulation period. Thus, it has better performance than the normal P&O algorithm (4.87%) but worse than the TPWC and IC algorithms (0.95%, 0.16%), respectively, for the same period. For the tracking speed during the same simulation period, the augmented P&O tracks the MPP with an average of 0.61 sec, while it was recorded as 0.8, 0.38, and 0.19 sec, respectively, for the normal P&O, TPWC, and IC algorithms.
A25 16:35-16:50	CNN–LSTM Spatiotemporal Modeling for Predicting Habitat Suitability of Venomous Snakes in the Philippine Authors: Jonh Alexis Buot, Sherly R. Jao Presenter: Jonh Alexis Buot, University of San Carlos, Philippines Abstract: Accurate prediction of venomous snake distribution is essential for ecological monitoring and public safety, particularly in biodiversity rich regions where systematic observational datasets are limited. This study proposes a spatiotemporal deep learning framework to predict the intensity of barangay-level snake encounters and habitat suitability in the Philippine archipelago. Environmental predictors derived from Dynamic World land cover data, ERA5 Land climate variables, and MODIS land surface temperature were integrated with administrator-validated snake sighting records ob tained from a moderated public identification community. A hybrid Convolutional Neural Network–Long Short-Term Memory (CNN LSTM) architecture was employed to capture spatial relationships amongenvironmental predictors and temporal dependencies across environmental time series. Separate models for three medically im portant species were trained: Naja philippinensis, Naja samarensis, and Ophiophagus hannah. Model performance was evaluated using mean absolute error (MAE) and root mean square error (RMSE) for one-day and seven-day prediction horizons. Results indicate stable short-term forecasting performance and spatially selective habitat suitability patterns across the Philippine archipelago. The findings demonstrate the feasibility of integrating community-reported eco logical observations with remote sensing data and spatiotemporal deep learning models for localized ecological forecasting in data limited environments
B3109 16:50-17:05	Phi-LOCK: Deterministic Control of Quantum Measurement Probabilities via Ry-CNOT Architecture Authors: Fatih Çağrı Bilgehan, Özkan Aslan Presenter: Fatih Çağrı Bilgehan, Afyon University, Turkey Abstract: We present Φ-LOCK, a quantum circuit protocol achieving deterministic control over measurement probabilities using a minimalist Ry-CNOT architecture. The protocol locks $P(\|00\rangle)=\varphi$ through the closed-form equation $\theta=2\arccos(\sqrt{\varphi})$, operating at the theoretical lower bound of a single

	CNOT gate. Validation on IBM ibm_fez (156 qubits) achieves R^2=0.9995 calibration accuracy. Extended experiments demonstrate noise tolerance, multi-qubit GHZ scaling to 6 qubits, and 98x speedup over variational methods with 2.8x lower error.
B4181 17:05-17:20	Quantum-Assisted High-Throughput Classical Messaging: Shared Secret Key Generation with Superdense Coding Authors: Zeynep Çelik, Hüseyin Bodur Presenter: Hüseyin Bodur, Düzce University, Turkey Abstract: This study proposes a quantum-assisted hybrid messaging architecture that integrates Superdense Coding (SDC)-based shared key generation with classical AES-256 symmetric encryption for high-throughput secure communication. Unlike conventional quantum key distribution (QKD) systems, the proposed model leverages entanglement-assisted classical capacity to improve key generation efficiency while maintaining compatibility with existing classical infrastructures. In the proposed framework, 256-bit shared secret keys are generated through repeated SDC operations. The generated keys are subsequently utilized in a classical AES-256 encryption layer for high-speed data transmission. Performance evaluation is conducted in a Python/Cirq simulation environment considering key generation latency, entropy analysis, throughput capacity, AES encryption time, and quantum channel noise effects under phase damping and amplitude damping models. Results indicate that SDC-based key generation achieves near-maximal entropy values while AES operations introduce negligible computational overhead compared to key generation. Noise analysis demonstrates the sensitivity of the quantum layer to channel decoherence, highlighting the necessity of error mitigation mechanisms for practical deployment. The proposed hybrid approach provides a transitional architecture that combines quantum-enhanced key generation with classical high-performance encryption, offering a scalable pathway toward future quantum-secure communication systems.
B3128 17:20-17:35	Temperature-Dependent Performance of ITO/NiO/$MAPbI_3$/ZnO/Al Perovskite Solar Cells Authors: Marwa A. Assi, Mohammad T. Yaseen, and Shamil H. Hussein Presenter: Shamil H. Hussein Alnajjar, University of Mosul, Iraq Abstract: The thermal instability of perovskite solar cells remains a major challenge limiting their long- term reliability and hindering their widespread commercialization. This work investigates the temperature-dependent photovoltaic performance and thermal stability of a perovskite solar cell with a NiO hole transport layer, $CH_3NH_3PbI_3$ absorber, and ZnO electron transport layer using SILVACO Atlas simulations. The absorber layer thickness was varied (250, 300, and 350 nm), while the transport layers were fixed at 40 nm, and the operating temperature ranged from 300 to 400 K. Device performance was evaluated in terms of open-circuit voltage (Voc), short- circuit current density (Jsc), fill factor (FF), and power conversion efficiency (PCE). The highest efficiency was obtained at 300 K for a 350 nm absorber thickness, achieving a PCE of 30.03%. Increasing temperature led to a gradual reduction in PCE for all thicknesses, primarily due to declines in Voc and FF, while Jsc exhibited weak temperature dependence. Among the studied configurations, the 250 nm absorber layer showed superior thermal

	stability, with only a 3.62% efficiency reduction between 300 and 400 K, compared to 3.92% and 4.07% for 300 and 350 nm thicknesses, respectively. The results show that thicker layers achieve higher efficiency at low temperatures, while increasing temperature leads to slight changes in energy levels and a limited reduction in the bandgap, with similar behavior across different thicknesses
B4218 17:35-17:50	Wind-Induced Cooling Effects on Photovoltaic Efficiency: A Monte Carlo-Based Analysis for the Marmara Region Authors: Kübra Çakır, Onur Elma Presenter: Kübra Çakır, Çanakkale Onsekiz Mart University, Turkey Abstract: Modern power systems have witnessed the beginning of technological advancements that have led to wind and solar energy becoming significant sources of renewable energy. The electricity performance of PV modules is, however, highly environmentally sensitive to operating temperatures, which depends on the meteorological conditions like the speed of wind. In this study, the convective cooling impact of the wind on the PV modules functionality has been taken into consideration using the meteorological data provided by NASA POWER database to the period between 2020 and 2024. The speed of wind is modified based on the PV panel height using wind power law. Faiman and Mattei thermal models are estimated to use the PV cell temperature. A stochastic analysis is done to solve the uncertainty with different parameters and weather conditions. Also, Monte Carlo analysis is used to execute the analysis. Wind-caused convective cooling has been found to enhance the efficiency of PV modules by up to 3.45 percent/year in the Çanakkale area of Marmara, Türkiye. Such results emphasize that wind-solar interactions should be considered when measuring PV performance on a regional scale and offer the information to guide wind and solar energy facility location selection and enhance the viability of renewable energy planning and policy formulation.
B4219 17:50-18:05	Active Power Estimation and Anomaly Detection Using Wind Turbine SCADA Data Authors: Kübra Çakır, Enes Yiğit Presenter: Kübra Çakır, Bursa Uludag University, Turkey Abstract: The reliable and efficient operation of wind energy systems is directly related to accurate power estimation and early detection of operational deviations. SCADA systems used in wind turbines enable the acquisition of sensor data for monitoring turbine behavior. In this study, short-term active power estimation was performed using SCADA data of a wind turbine, and anomaly detection was carried out based on the estimation model. Linear regression, Random Forest, Histogram-Based Gradient Boosting, and Multilayer Perceptron (MLP) models were compared in the study. Lagged features were generated to capture time dependence. Experimental results showed that the MLP model achieved an accuracy rate of approximately R2=0.996, MAE=13.99, and RMSE=30.70 in the test data. Error-based anomaly analysis was performed using the obtained prediction errors, and deviations in sensor behavior were also examined by applying the Isolation Forest algorithm in the sensor space. The results demonstrate that the combined use of power estimation and anomaly detection provides an effective approach for operational monitoring of wind turbines.

B1023 18:05-18:20	Optimizing Load Profiles in Industrial Microgrids through Demand-Side Management: Enabling Photovoltaic Integration for Moroccan Industry Authors: Badr Attary, Mohamed Ouassaid, Mohammed Mokhtari Presenter: Badr Attary, Mohammed V University in Rabat, Morocco Abstract: The industrial sector in Morocco faces persistent challenges linked to high electricity costs and limited flexibility in adopting renewable energy solutions. This paper presents a proof of concept for the application of demand-side management (DSM) through rule-based load shifting in a grid connected industrial microgrid. Using real Moroccan industrial load data disaggregated into four categories, along with simulated photovoltaic (PV) generation from National Renewable Energy Laboratory (NREL) irradiance data and the national time-of-use (TOU) tariff, the study evaluates the impact of DSM on key performance indicators (KPIs). Results show that rescheduling 60% of fully flexible and 40% of partially flexible loads during high PV availability leads to measurable improvements in summer: grid energy imports decrease by 2.2%, renewable penetration and utilization increase by 1.47%, and grid costs are reduced by 3.1%. In winter, where PV penetration is intrinsically low, DSM achieves only modest benefits, primarily through tariff-driven cost savings (1.84%) and peak shaving. These findings establish a practical baseline for Moroccan industry, showing that DSM can yield measurable savings under real tariff conditions while underlining the need for battery energy storage systems (BESS) to extend renewable benefits into low-irradiance periods and further enhance economic and operational performance.