AETA 2025

The 10th International Conference on Advanced Engineering - Theory and Applications 2025

11 – 13 December, 2025

Conference Program

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Ton Duc Thang University, Vietnam

Co-Organizers
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VŠB-Technical University of Ostrava, Czech Republic
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Proceedings

The AETA 2025 proceedings are collected in the **Lecture Notes in Electrical Engineering of Springer** "AETA 2025 - Recent Advances in Electrical Engineering and Related Sciences: Theory and Application"

AETA 2025
Website: https://aeta2025.tdtu.edu.vn/
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CONFERENCE INFORMATION

I. Location:

Tan Hung Campus - Ton Duc Thang University

No. 19, Nguyen Huu Tho St., Tan Hung Ward, Ho Chi Minh City, Vietnam

II. Reception Desk:

The reception desk is located on the ground floor of Building A and opened from 7:30 to 17:40 on 11th December and from 07:30 to 11:00 on 12th December, 2025

III. Language

All sessions will be presented in English.

IV. Badges

Admittance to the venue is restricted to participants wearing their name badges. The wearing of badges is compulsory both inside the venue and at all events organized with its context.

V. Conference Room's Location

Conference will be held in the conference rooms of Buildings A, B, and C.

VI. Conference Room's Equipment

Each conference room will be equipped with a projector and a notebook computer.

VII. Guideline for Presentation

It takes 18 minutes for each presentation. Each paper will be presented orally for 12-15 minutes followed by 3-6 minutes discussion. Speakers will be noticed by the supporting staff 5 minutes before ending.

VIII. Transportation

- Tan Son Nhat International Airport ⟺ Ton Duc Thang University (TDTU)
  - ✓ BUS:

    First, take the bus No. 109 air-con airport (Tan Son Nhat Airport – Sai Gon bus station). Direction: Bound for Sai Gon bus station and get off at Transit Hub Center at Ham Nghi Street (Fare: approximately 0.7$; working hour:05:30-22:15; running frequency: 4-5/hour)

    Then take the bus No. 86 (Van Lang University - Ton Duc Thang University). Direction: Bound for Ton Duc Thang University (Terminal - inside university) (Fare: approximately 0.3$; working hour:05:00-19:00; running frequency: 4/hour)
  - ✓ TAXI: It takes about US$ 10-12, and about 40 minutes to arrive at Ton Duc Thang University.

    Taxi Mai Linh: https://mailinh.vn/

    Taxi Vinasun: https://vinasun.vn/
  - ✓ Ride-hailing services: Grab, Be, Xanh SM

IX. Parking

Participants with the conference invitation can park their cars at campus parking lots following instructions.

X. Luncheon

Lunch will be served from 12:05 to 13:40 on the 11th floor building D during the conference.

XI. Conference Banquet

The Organizing Committee requests the pleasure of meeting all registered guests at the Conference Dinner on 11th December at Kim Do Royal Hotel, 133 Nguyen Hue Street, Sai Gon Ward, Ho Chi Minh City.

XII. Contact

Dr. Huynh Van Van Mobile number: +84 907 114 607

Email : aeta2025@tdtu.edu.vn

CONFERENCE VENUE

Ton Duc Thang University

No. 19, Nguyen Huu Tho Street, Tan Hung Ward, Ho Chi Minh City

Telephone: (84-28) 37 755 035

TON DUC THANG UNIVERSITY

"Liberal Education for Comprehensive Human Development"

Ton Duc Thang University (TDTU) is a public and autonomous university. Established in 1997, it is situated in the center of Ho Chi Minh City - the commercial hub of Vietnam. The university has four campuses in Ho Chi Minh City (two campuses), Nha Trang City, and Lam Dong Province. The main campus is located in an area of 265,000 m^2 in Tan Hung Ward, Ho Chi Minh City, Vietnam.

TDTU is a young and dynamic provider in the higher education sector and is one of the largest universities in Vietnam. The university is committed to Vietnam's sustainable development of human resources. It strives to be a leading research-oriented university regionally and internationally.

The university has been fostering a unique culture that distinguishes itself from the others. Aiming to provide optimal opportunities for quality education, the university is devoted to the promotion of students' learning and research activities. All aspects of the university strive to constantly maintain an effective and efficient academic community for talents to be developed.

After 28 years of development, TDTU has become one of the fastest growing universities in the country. Currently, the university has 16 faculties, 15 centers for technology applications, 05 institutes, 10.314 journals, and several laboratories. The university offers over 82 programs and 21 joint training programs at undergraduate and postgraduate levels. There are approximately 26,000 students pursuing their study at the university.

Equipped for more than just studying, TDTU also provides facilities for post-study workouts. The main campus affords a sports complex in which lots of indoor games such as badminton, tennis, volleyball, basketball and many

other activities can be played. Furthermore, there is a swimming pool and a FIFA 2-star football stadium. There are four fully equipped dormitories, which can accommodate up to 5,831 students.

TDTU considers the connection with international partners through strategic cooperation as an important prerequisite for its sustainable development. Thus, more and more research projects have been initiated, established and conducted in the university with the leadership of internationally recognized experts. The partnerships with nearly 163 universities from different parts of the world also allow the university to exchange students, staff and training collaborations.

As a young and vibrant institution with numerous learning pathways for students internationally and diversified opportunities for academic development, TDTU is committed to being the best choice of students, academic staff, researchers and all stakeholders.

PROGRAM AT A GLANCE – AETA 2025

DAY 1 – 11 December, 2025 Thursday

Time	Event			
07:30 ~ 08:45	**Registration**			
	Auditorium 2A			
09:00 ~ 09:40	**Opening Ceremony**			
09:40 ~ 10:00	**Coffee Break**			
10:00 ~ 10:45	**Keynote Speech I: Quantum Technologies in 6G Networks: Opportunities and Challenges** **Keynote Speaker: Prof. MIROSLAV VOZŇÁK**			
	Room A101	**Room B010**	**Room C010**	**Room A403**
10:55 ~ 12:05	Session A-1 **Robotics**	Session B–1 **Signal Processing**	Session C–1 **Mechatronics**	Session D-1 **Material Science**
12:05 ~ 13:40	**Lunch**			
	Room A403			
13:40 ~ 14:25	**Keynote Speech II: Recent advancements in the GenAI-driven design and discovery of algorithms** **Keynote Speaker: Prof. ROMAN ŠENKEŘÍK**			
	Room A101	**Room B010**	**Room C010**	**Room A403**
14:35 ~ 16:05	Session A-2 **Control Systems 1**	Session B–2 **Power Systems 1**	Session C–2 **Wireless Technologies 1**	Session D-2 **Industrial Session**
16:05 ~ 16:20	**Coffee Break – Session P-1 (Poster)**			
16:20 ~ 17:50	Session A–3 **Control Systems 2**	Session B–3 **Power Systems 2**	Session C-3 **Wireless Technologies 2**	Session D-3 **Intelligent Networks**
19:00 ~ 21:00	**Conference Banquet**			

DAY 2 – 12 December, 2025 Friday

Time	Event			
	Room A403			
08:00 ~ 08:40	**Keynote Speech III: Study of GaN high electron mobility transistors for the high power and high frequency device applications** **Keynote Speaker: Prof. WU-CHING CHOU**			
	Room A101	**Room B010**	**Room C010**	**Room A403**
08:50 ~ 09:45	Session A–4 **Power Electronics 1**	Session B–4 **Computer Science**	Session C-4 **Sustainable Energy 1**	Session D-4
09:45 ~ 09:55	**Coffee Break**			
09:55 ~ 10:35	**Tutorial on Quantum Algorithms** **Tutor: Prof. IVAN ZELINKA**			
10:40 ~ 12:10	Session A–5 **Power Electronics 2**	Session B–5 **Artificial Intelligence**	Session C-5 **Sustainable Energy 2**	Session D–5 **Quantum Engineering**
12:10 ~ 13:40	**Lunch**			

DAY 3 – 13 December, 2025 Saturday

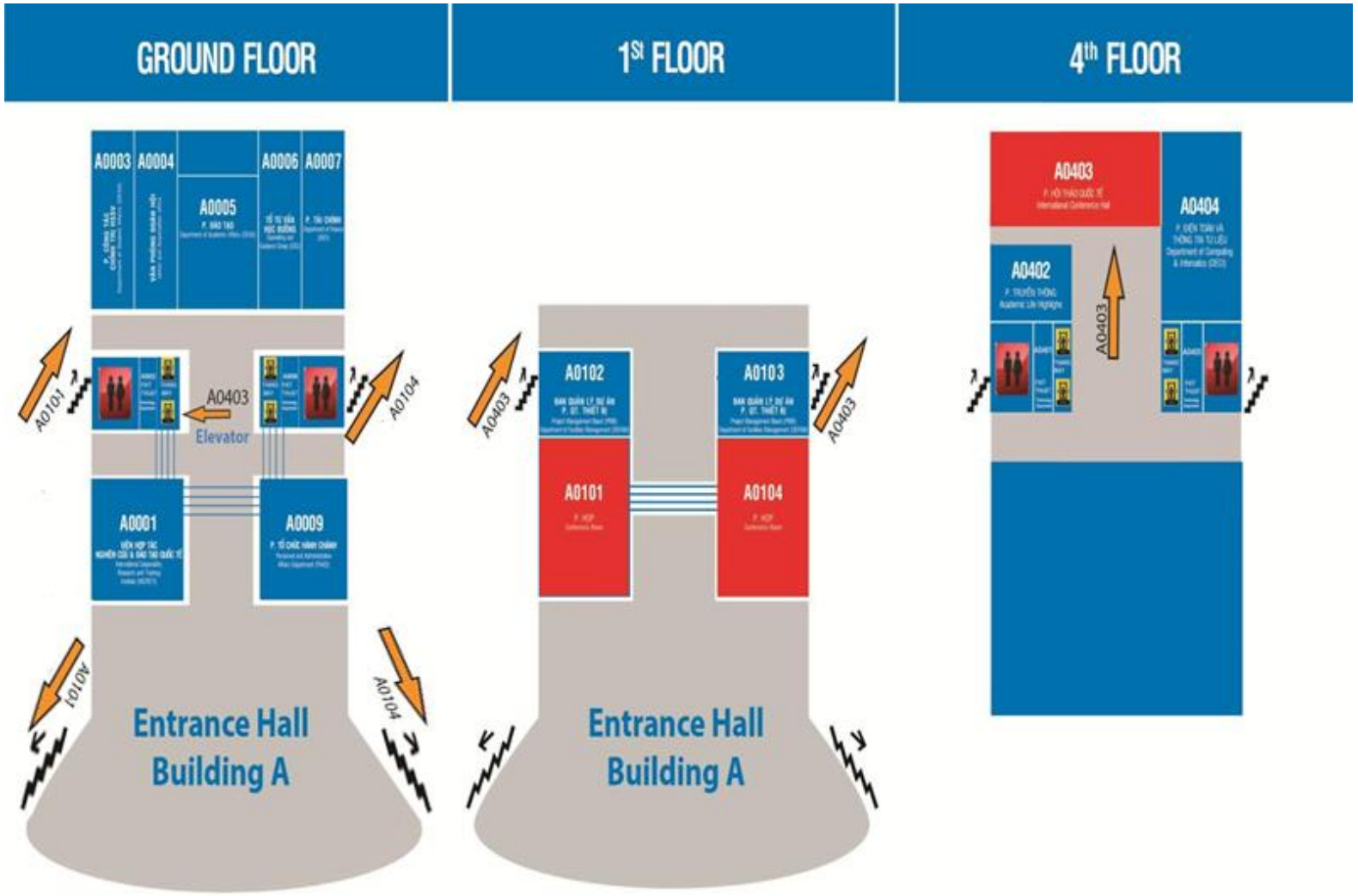
Time	Event
08:00 ~ 15:00	**City Tour**

Notes:

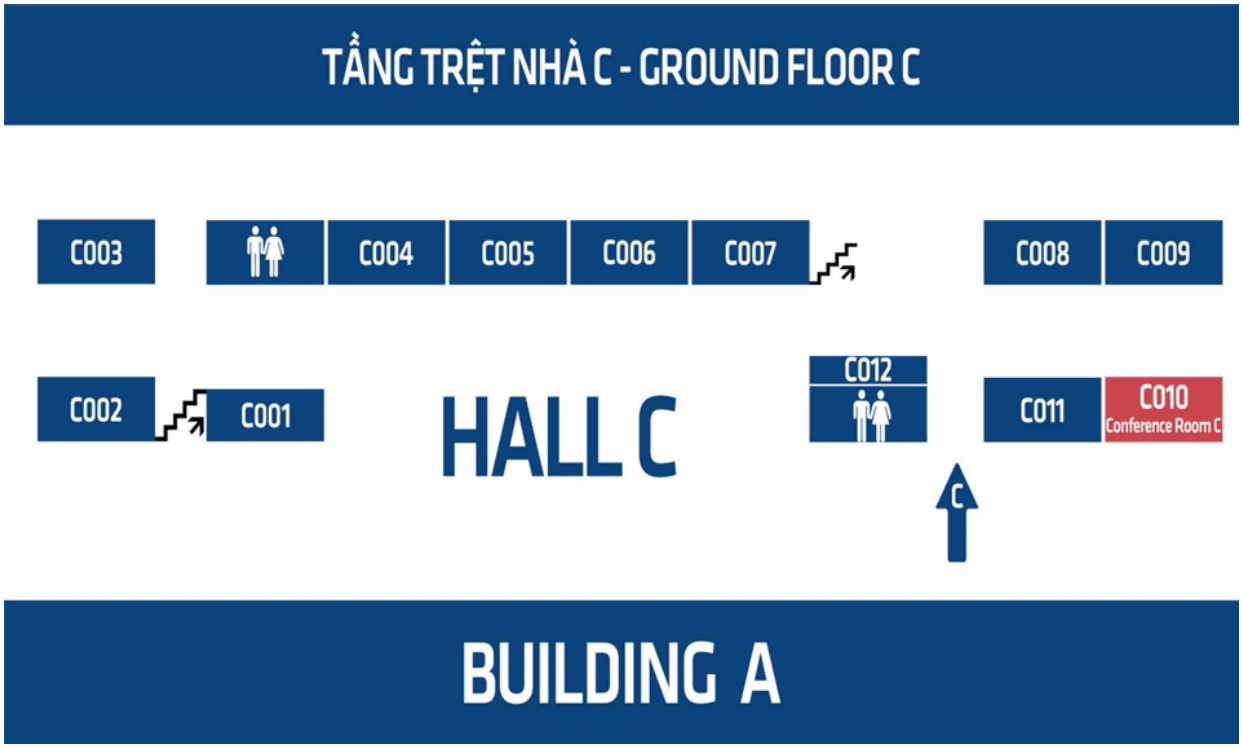
- **Room A101** is located on the 1st floor of Building A. Please use one of 2 stairs at the right side of Building A to access A101
- **Room A403** is located on the 4th floor of Building A. You can use the elevator or any stairs around Building A to access A403.
- **Room B010** is located on the ground floor of Building B.
- **Room C010** is located on the ground floor of Building C.

TDTU MAP


BUILDING H
BUILDING I
BUILDING I
BUILDING H
MULTI-PURPOSE ARENA
STADIUM
GUEST HOUSE
INDUSTRIAL FINE ARTS WORKSHOP
CANTEEN
PARKING LOT
BRIDGE
BUILDING D
BUILDING F
BUILDING C
BUILDING A
BUILDING B
BUILDING E
BUILDING G
NGUYEN HUU THO STREET
BUILDING B
Conference Room B (B010)
BUILDING E
BUILDING C
Conference Room C (C010)
BUILDING A
A403
A101
A104
BUILDING G
BUILDING F
Auditorium 10F (Opening Ceremony)
F301
F312
F507


GROUND FLOOR
1ST FLOOR
4th FLOOR
A0003
A0004
A0005
A0006
A0007
A0101
A0403
Elevator
A0104
A0001
A0009
A0101
A0104
Entrance Hall
Building A
A0102
A0103
A0403
A0101
A0104
A0403
Entrance Hall
Building A
A0403
A0402
A0403
A0404


TẦNG TRỆT NHÀ B - GROUND FLOOR B
B009
B008
B007
B006
B005
B004
B003
B010
Conference Room B
B011
B012
B
HALL B
B001
B002
BUILDING A


TẦNG TRỆT NHÀ C - GROUND FLOOR C
C003
C004
C005
C006
C007
C008
C009
C002
C001
HALL C
C012
C
C011
C010
Conference Room C
BUILDING A

KEYNOTE SPEAKERS

Professor MIROSLAV VOZNAK

Professor ROMAN SENKERIK

Professor WU-CHING CHOU

Professor MIROSLAV VOZNAK
Head, Department of Telecommunications
VSB-Technical University of Ostrava, Ostrava, Czech Republic

Keynote Speech I
11 December 2025
Thursday
10:00 ~ 10:45
Auditorium 2A

Lecture title: Quantum Technologies in 6G Networks: Opportunities and Challenges

Abstract: The keynote will deal with the transformative role of quantum technologies in 6G networks, highlighting practical opportunities, technical challenges, and the roadmap from research to real-world deployment. It is divided into three parts. The first part will address the general challenges of implementing quantum technologies in 6G networks, illustrating each with examples. The second part will focus on security, with an emphasis on quantum key distribution (QKD) and post-quantum cryptography (PQC). The third part of the keynote will present experiences from international projects, summarize efforts for interoperability between vendors, pilot projects, and recent achievemnts in the field of quantum communications.

Biography: Miroslav VOZNAK (IEEE Senior Member) is a professor in the Faculty of Electrical Engineering and Computer Science at the VSB - Technical University of Ostrava, Czechia. His research interests include IoT, QoS/QoE, wireless networks, network security, and big data analytics in networks. He published several books, the last one on Quantum Key Distribution was issued by Springer Nature. Since 2020, he has been regulary ranked by Stanford University among the top 2% of scientists in the world (Career Impact DB) in the subfield of Networks and Telecommunications.
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Professors ROMAN SENKERIK
Head of A.I. laboratory,
Head of the evolutionary computing research group,
Tomas Bata University in Zlin, Czech Republic

Keynote Speech II
11 December 2025
Thursday
13:40 ~ 14:25
Room A403

Lecture title: Recent advancements in the GenAI-driven design and discovery of algorithms

Abstract: Large language models (LLMs) are transforming how we create and automate AI techniques. We are moving beyond just hyperparameter tuning and automated selection into the automated design and discovery of algorithms, architectures, and end-to-end pipelines that connect ideation with evaluation. This tutorial provides an overview of the rapidly evolving landscape, including frameworks such as EASE, LLaMEA, AlphaEvolve, FunSearch, and emerging AI-driven assistants.

Special emphasis will be placed on EASE (Effortless Algorithmic Solution Evolution), which serves as a practical, fully modular framework for iterative closed-loop generation and evaluation. Beyond generating algorithm code, EASE can also create text and graphics iteratively.

Biography: **Prof. Roman Senkerik** received his Ph.D. degree in Technical Cybernetics from the Tomas Bata University in Zlin, Czech Republic in 2008. He is currently a full professor at the Tomas Bata University in Zlin, Faculty of Applied Informatics. His research interests include interdisciplinary applications of evolutionary computation, modification and development of evolutionary and swarm-based algorithms, computational intelligence, optimization, cyber-security, theory of chaos, emergence and complexity.

Professor WU-CHING CHOU
Department of Electrophysics,
National Yang Ming Chiao Tung University, Taiwan

Keynote Speech III
12 December 2025
Friday
08:00 ~ 08:40
Room A403

Lecture title: Study of GaN high electron mobility transistors for the high power and high frequency device applications

Abstract: High-frequency, high-power GaN high electron mobility transistors (HEMTs) are critical components in applications such as mobile communications, electric vehicle energy management, artificial intelligence (AI) server power supplies, and satellite systems. However, challenges remain in achieving high breakdown voltage, low contact resistance, high sheet carrier density, and enhanced electron mobility to further improve GaN HEMT performance. Recently, we demonstrated that inserting an InN nano-mask into the low-temperature GaN buffer layer significantly reduces dislocation density and increases breakdown voltage. The layer-resolved dislocation density distribution and stress evolution in GaN HEMTs were revealed using X-ray nano-diffraction. Furthermore, employing a GaN:C film on a GaN:Fe buffer effectively reduces buffer leakage current and suppresses Fe diffusion

Biography: Prof. WU-CHING CHOU received his Ph.D. degree in Physics at State University of New York at Buffalo, USA in 1992. He is currently a full professor at the Department of Electrophysics, National Yang Ming Chiao Tung University, Taiwan. His research interests include Molecular Beam epitaxy of ZnO-based and GaN-based Photonics and Magnetic Semiconductors, Optical Spectroscopy and Cathodo-luminescence of Semiconductors, Condensed Matter Physics.

ORAL PRESENTATION

Day 1 – 11 December, 2025 Thursday

Session A–1, B-1, C-1, D-1:	**10:55 ~ 12:05**
Session A–2, B-2, C-2, D-2:	**14:35 ~ 16:05**
Session A–3, B-3, C-3, D-3:	**16:20 ~ 17:50**

Day 2 – 12 December, 2025 Friday

Session A–4, B-4, C-4, D-4:	**08:50 ~ 09:45**
Session A–5, B-5:	**10:40 ~ 12:10**

Session A-1 – Robotics
Day 1 – 11 December, 2025 Thursday
Time: 10:55 ~ 12:05; Venue: Room A101
Session Chair: Dr. Shen Hin Lim (The University of Waikato, New Zealand)
Co-session Chair: Dr. Le Anh Vu (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	10:55 ~ 11:12	**Complete Coverage Path Planning Applying Bio-inspired Neural Network for Reconfigurable Robot** Cong Hien Dinh, Anh Vu Le, Van Van Huynh, and Rajesh Elara Mohan
2	11:13 ~ 11:30	**PIPE-I Mini - Design and Implementation of a 3D SLAM Capable Robot** Nicholas McAdam, Andrew Sun Che-Ming Chang, Ben McGuinness, Mike Duke, and Shen Hin Lim
3	11:31 ~ 11:48	**Optimisation of 3D-Printed Lattice Structures for Reduced Contact Pressure in Robotic Fruit Harvesting** Benjamin McGuinness, Hin Lim, Mike Duke, Ajit Pal Singh
4	11:48 ~ 12:05	**Monocular camera-based tabletop robot system for joint attention training** Jun-Young Jang, Sung-Jin Jang, Kyu-Young Lee, Chun-Sung Park and Sang Seok Yun
12:05 ~ 13:40		Lunch

Complete Coverage Path Planning Applying Bio-inspired Neural Network for Reconfigurable Robot
Cong Hien Dinh[1], Anh Vu Le[1], Van Van Huynh[1], and Rajesh Elara Mohan[2]
[1]Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam, Ho Chi Minh City, Vietnam
[2]ROAR Lab, Engineering Product Development, Singapore University of Technology and Design, Singapore

Abstract. This paper presents a novel energy-aware complete cover age path planner, termed EGBNN(n), developed for an expandable and compressible omnidirectional robot (FAOR) that can operate under n distinct reconfiguration states. The proposed framework extends the classical Glasius Bio-Inspired Neural Network (GBNN) by integrating morphological adaptation into its neural activity field, thereby enabling the robot to dynamically modify its footprint to suit varying spatial conditions. Unlike conventional CCPP algorithms designed for fixed-structure robots, EGBNN(n) jointly optimizes coverage completeness, energy efficiency, and traversal smoothness within a unified neural model. The algorithm was benchmarked against several state-of-the-art methods, and experimental findings demonstrate that EGBNN(n) significantly reduces the total number of steps, path length, and overall energy consumption in both simulated and real-world scenarios. The results further indicate that EGBNN(n) performs optimally in open and semi-structured environments, while maintaining comparable performance to existing CCPP methods in regions containing narrow or dead zones. Future work will extend this study to include multi-environment evaluations and collaborative coverage scenarios using multiple reconfigurable agents.
Keywords: GBNN, Configurable Robot, EGBNN, Complete Coverage Path Planning, Genetic algorithm optimization, Energy cost.

PIPE-I Mini- Design and Implementation of a 3D SLAM Capable Robot
Nicholas McAdam[1], Andrew Sun Che-Ming Chang[1], Ben McGuinness[1], Mike Duke[1], and Shen Hin Lim[1]
[1]Schoolf of Engineering, University of Waikato, Hamilton 3240, New Zealand

Abstract. This paper presents the design and implementation of PIPE I Mini, a new compact and portable mobile robot capable of performing 3D Simultaneous Localization and Mapping (SLAM) in underground environments such as tunnels and culverts. The new robot is built on a six-wheel chassis and is equipped with a Livox Mid-360 LiDAR, two Intel RealSense D455 RGB-D cameras, and an onboard LattePanda Sigma computer. The system

utilizes ROS2 as the software framework, enabling seamless integration of sensors and SLAM algorithms. The robot's design emphasizes modularity, ease of maintenance, and real-time performance, making it suitable for deployment in challenging environments. The SLAM algorithms were first tested in the standard hospital environment and then in the built-for-purpose tunnel environment. Simulation results demonstrated the robot's capability to map both hospital and tunnel environments accurately. Results showed a drift of approximately 0.36% in the hospital environment and 0.42% in the tunnel environment over distances of 42m and 240m respectively. The robot effectively balances accurate mapping of its surroundings while maintaining low computational overhead, highlighting its potential for practical applications in infrastructure inspection and environmental monitoring.
Keywords: SLAM, autonomous vehicles, sensor fusion.

Optimisation of 3D-Printed Lattice Structures for Reduced Contact Pressure in Robotic Fruit Harvesting
Benjamin McGuinness[1], Karan Dhanotra, Christoff Venter, Hung Phan Le, Eva Prinz, Shen Hin Lim[1], Mike Duke[1], and Ajit Pal Singh[1]
[1]*Schoolf of Engineering, University of Waikato, Hamilton 3240, New Zealand*

Abstract. This study investigates the design and performance of 3D-printed lattice structures for application in soft robotic grippers. Several geometries and thicknesses were tested under compression to characterise stiffness, constant-stress regions, and pressure distribution when grasping delicate objects. Results show that lattice geometry strongly influences mechanical response: gyroid structures provided the greatest control over stiffness while maintaining extended plateau regions, whereas cubic and Schwarz primitive geometries showed limited sensitivity to thickness. Importantly, pressure and displacement varied widely across designs, demonstrating that contact area alone is insufficient to evaluate grasping performance. Instead, understanding the pressure distribution is essential to ensure gentle yet reliable handling. These findings highlight the potential of lattice-based finger designs to tailor mechanical properties for specific soft-gripping applications.
Keywords: Soft robotics, compliant mechanisms, 3D-printed lattices, pressure distribution, mechanical characterization, gripper design.

Monocular camera-based tabletop robot system for joint attention training
Jun-Young Jang[1], Sung-Jin Jang[2], Kyu-Young Lee[2], Chun-Sung Park[2], and Sang Seok Yun[3]
[1]*Advanced Convergence Technology Center, Silla University, Busan, Korea*
[2]*Field Robotics Division, Clobot, Seongnam-si, South Korea*
[3]*Department of Mechanical Engineering, Silla University, Busan, South Korea*

Abstract. In this paper, we propose a system designed to facilitate social interaction training with a robot through the estimation of the user's gaze direction and the establishment of joint attention. The system involves extracting RGB images from an affordable webcam, capturing the user's head pose using the Open Face module, and utilizing geometry to estimate the user's gaze direction in three-dimensional space. Additionally, it estimates the coordinates of the user's focal point by determining the intersection of the estimated gaze direction with the table plane. The system computes the robot's gaze angle relative to the user's focal point using robot kinematics and homogeneous coordinates derived from the user's position. The pan-tilt module of the robot's head is then controlled to establish joint attention between the human user and the robot. To evaluate the system's performance, we conducted tests to assess the kinematic error by estimating the user's gaze point and maneuvering the robot's head to various locations within an indoor environment, including tables and robots. The system exhibited precision for distinguishing user gaze and facilitating eye contact. Accordingly, it was confirmed that these findings can serve as quantitative evidence for the effectiveness of attention training in the context of human-robot interaction.
Keywords: Human-robot interaction, joint attention, eye contact, socially assistive robots, autism.

Session A-2 – Control Systems 1
Day 1 – 11 December, 2025 Thursday
Time: 14:35 ~ 16:05; Venue: Room A101
Session Chair: Dr. Vu Tri Vien (Ton Duc Thang University, Vietnam)
Co-session Chair: Dr. Vo Tan Phuoc (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	14:35 ~ 14:52	**Online Training of PID Controller Using Neural Network Combined with Recurrent Fuzzy Neural Network Identifier Applied on Liquid Level Stabilization** Minh-Thanh Le, Thanh Duy Vo
2	14:53 ~ 15:10	**A Novel Intelligent Control Strategy for Ball and Beam System Using Single Neuron Adaptive PID algorithms based on Recurrent Fuzzy Neural Network Identifier** Minh-Thanh Le, Minh Ngoc Luu
3	15:11 ~ 15:28	**Comparative Analysis of Direct Torque Control Strategies for PMSM Drive** Son Hai Hoang, Trung Van Nguyen, Hau Huu Vo, Phuoc Tan Vo, Nam Hoang Nguyen, and Thinh Cong Tran
4	15:29 ~ 15:46	**Online Recursive Identification of Discrete Transfer Function Using Real Interpolation Method** Nguyen Quang Dung, Hau Huu Vo, Tri-Vien Vu, Renato De Leone
5	15:47 ~ 16:05	**Field-Oriented Control for PMSM and IM Drives: Comparative Simulations** Tri Quang Thieu, Tai Huu Le, Hau Huu Vo, Chau Si Thien Dong, Duy Hoang Vo, Dao Trong Tran
16:05 ~ 16:20		Coffee Break – Poster session

Online Training of PID Controller Using Neural Network Combined with Recurrent Fuzzy Neural Network Identifier Applied on Liquid Level Stabilization
Minh-Thanh Le[1], Thanh Duy Vo[1]
[1]*Vinh Long University Technology of Education, Vinh Long City, Vietnam*

Abstract. Maintaining a stable fluid level in multi-tank systems is a crucial task in various industrial applications, including oil refining, chemical processing, paper production, and water treatment. This paper presents an adaptive proportional–integral–derivative (PID) control method based on a single neural network combined with a recurrent fuzzy neural network identifier (SNA-PID-RFNNI) for a two-tank interacting system (TTIS). The PID parameters are adaptively tuned in real time by a single neural network; this process is supervised by a recurrent fuzzy neural network identifier (RFNNI) through a parameter known as the Jacobian. Simulation results obtained in MATLAB/Simulink are evaluated against the performance of a PID controller, a Fuzzy-PID controller, and an adaptive fuzzy proportional–integral sliding mode controller (AFPISMC). The findings indicate that the proposed controller demonstrates superior control capability, with a rise time of 0.1742s, a settling time of 0.2851s, and an overshoot of 0.2751%. Future work will involve implementing the proposed controller on an experimental setup to further validate its effectiveness.
Keywords: Liquid level process dynamics, TTIS, SNA-PID-RFNNI, neuron assisted PID tuning, nonlinear system identification.

A Novel Intelligent Control Strategy for Ball and Beam System Using Single Neuron Adaptive PID algorithms based on Recurrent Fuzzy Neural Network Identifier
Minh-Thanh Le[1] and Minh Ngoc Luu[1]
[1]*Vinh Long University of Technology Education, 73 Nguyen Hue Street, Ward Long Chau, Vinh Long province*

Abstract. This paper proposes a novel intelligent control strategy for the ball and beam balancing system using a Single Neuron Adaptive PID (SNA-PID) controller integrated with a Recurrent Fuzzy Neural Network Identifier (RFNNI). The ball and beam mechanism represents a highly nonlinear and inherently unstable single input-multi output system, which poses significant challenges for conventional control methods. To address these issues, the pro-posed SNA-PID-RFNNI approach adaptively tunes control parameters based on the online identification capability of the RFNN, enhancing robustness and dynamic response. Simulation studies carried out in MATLAB/Simulink demonstrate that the proposed controller achieves faster settling time, minimal overshoot, and improved stability compared to the traditional PID controller. The obtained results confirm the effectiveness of the proposed intelligent control scheme, which provides a foundation for future real-time implementation on a DSP-based experimental platform with infrared sensing feedback.
Keywords: Ball and beam system, intelligent control, nonlinear, PID, SNA PID-RFNNI, MATLAB/ Simulink

Comparative Analysis of Direct Torque Control Strategies for PMSM Drive

Son Hai Hoang[1], Trung Van Nguyen[!], Hau Huu Vo, Phuoc Tan Vo[1], Nam Hoang Nguyen[!], and Thinh Cong Tran[1]
[1]Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam

Abstract. The paper deals with comparison of two strategies of direct torque control (DTC) in permanent magnet synchronous motor (PMSM) drive. At first, mathematical model of the PMSM is presented. Then, computation process of input quantities of the DTC is shown. Next, main parts of two drive strategies including Takahashi's DTC method (TDTC) and pulse-width-modulation DTC one (PDTC) are mentioned. Finally, blocks of de-exciation unit and speed controller are carried out. Comparative simulations are implemented in Matlab/Simulink environment. Evaluation criterions including ripples, responses characteristics are utilized to compare two drive methods. Simulations and assessments confirm the expected performance of the PDTC.
Keywords: permanent magnet synchronous motor drive, direct torque control, switching table, proportional-integral controller, pulse-width-modulation.

Online Recursive Identification of Discrete Transfer Function Using Real Interpolation Method

Nguyen Quang Dung[1], Hau Huu Vo[1], Tri-Vien Vu[1], Renato De Leone[2]
[1]Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam
[2]School of Science and Technologies, University of Camerino

Abstract. The paper deals with comparison of two strategies of direct torque control (DTC) in permanent magnet synchronous motor (PMSM) drive. At first, mathematical model of the PMSM is presented. Then, computation process of input quantities of the DTC is shown. Next, main parts of two drive strategies including Takahashi's DTC method (TDTC) and pulse-width-modulation DTC one (PDTC) are mentioned. Finally, blocks of de-exciation unit and speed controller are carried out. Comparative simulations are implemented in Matlab/Simulink environment. Evaluation criterions including ripples, responses characteristics are utilized to compare two drive methods. Simulations and assessments confirm the expected performance of the PDTC.
Keywords: permanent magnet synchronous motor drive, direct torque control, switching table, proportional-integral controller, pulse-width-modulation.

Field-Oriented Control for PMSM and IM Drives: Comparative Simulations

Tri Quang Thieu[1], Tai Huu Le[1], Hau Huu Vo[1], Chau Si Thien Dong[1], Duy Hoang Vo[1], Dao Trong Tran[1]
[1]Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam

Abstract. The paper deals with comparative simulations for field-oriented control (FOC) applied to permanent magnet synchronous motor (PMSM) and induction motor (IM) drives. Firstly, the PMSM and the IM are mathematically modeled. presented. Common computation blocks of the FOC for both motors are deployed in next section. Individual notes and additions for each motor are carried out. The FOC with sinusoidal pulse-width-modulation technique for two motors is simulated in Matlab/Simulink software. Evaluations using computation complexity, responses of flux-component and torque-component currents are employed. Results confirm the desirable performance of the FOC for both PMSM and IM.
Keywords: field-oriented control (FOC), permanent magnet synchronous motor (PMSM), induction motor (IM), IM current model, rotor time constant.

Session A-3 – Control Systems 2
Day 1 – 11 December, 2025 Thursday
Time: 16:20 ~ 17:50; Venue: Room A101
Session Chair: Dr. Quoc-Hoan Tran (Tran Dai Nghia University, Vietnam)
Co-session Chair: Dr. Vo Huu Hau (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	16:20 ~ 16:37	**A Three-Vector Fixed Switching Frequency Model Predictive Control of Three-Level T-Type Inverters** Quoc-Hoan Tran, Huu-Cong Vu
2	16:38 ~ 16:55	**A Model Predictive Control Strategy for Common Mode Voltage Suppression and Enhanced Current Quality in Dual Seven-Phase Inverters** Quoc-Hoan Tran, Dong Duy-Anh, Huu-Cong Vu
3	16:56 ~ 17:13	**Evaluation of a GWO-Based Control Algorithm for DC Motor with Load Perturbations** Phong Thanh Tran, Anh Tuan Huynh Nguyen, and Ngoc Hong Nguyen, Hai Huu Dang
4	17:14 ~ 17:31	**Influence of Sliding Surface Order on Disturbance Rejection, Stability, and Robustness in Multi-Area Smart Grids** Phong Thanh Tran, Tuan Van Huynh and Hai Huu Dang, Ngoc Hong Nguyen, Dieu Ngoc Vo
5	17:32 ~ 17:50	**Design and Implementation of a Two-Wheel Legged Robot** Tan-Phi Truong Ho, Cuong-Quoc Lam Thai, and Tri-Vien Vu

A Three-Vector Fixed Switching Frequency Model Predictive Control of Three-Level T-Type Inverters
Quoc-Hoan Tran[1], and Huu-Cong Vu[2]
[1]*Faculty of Standards, Metrology and Quality, Tran Dai Nghia University, Ho Chi Minh City, Vietnam*
[2]*Department of Electrical Engineering, Hanoi University of Civil Engineering, Hanoi, Vietnam*

Abstract. Aiming to address the variable switching frequency problem in model predictive control (MPC) of three-level T-type inverters, this paper proposes a three-vector fixed switching frequency MPC method. The approach employs spatial sector division to simplify voltage vector selection and reduce the range of basic voltage vectors involved in model predictive calculation, thereby minimizing computational complexity. The proposed method compensates for digital implementation delay via a two-step delay time compensation scheme. A multi-objective cost function regulates both reference current tracking and DC side neutral-point voltage balance. Comparative simulation studies confirm the proposed method ensures stable inverter operation with fixed switching frequency, effectively reducing output current total harmonic distortion (THD), enhancing dynamic response, and regulating neutral-point voltage. The scheme demonstrates superior control performance and offers an effective solution to variable switching frequency in MPC-controlled three-level T-type inverters.
Keywords: Three-Level T-Type Inverter, Model Predictive Control, Fixed Switching Frequency.

A Model Predictive Control Strategy for Common Mode Voltage Suppression and Enhanced Current Quality in Dual Seven-Phase Inverters
Quoc-Hoan Tran[1], Dong Duy-Anh[2], and Huu–Cong Vu[3]
[1]*Faculty of Standards, Metrology and Quality, Tran Dai Nghia University, Ho Chi Minh City, Vietnam*
[2]*School of Electrical and Electronic Engineering, Hanoi University of Science and Technology, Hanoi, Vietnam*
[3]*Faculty of Mechanical Engineering, Hanoi University of Civil Engineering, Hanoi, Vietnam*

Abstract. This work introduces an advanced model predictive control (MPC) technique designed for dual seven-phase inverters (DSPIs) that simultaneously achieves common-mode voltage (CMV) suppression and harmonic current reduction. The methodology incorporates fifteen synthesized virtual voltage vectors that completely nullify CMV while simultaneously attenuating lower-order harmonic components in the output current. Additionally, the

control framework derives a reference voltage vector that obviates explicit current prediction computations. During each control cycle, the algorithm optimally identifies three virtual voltage vectors to achieve minimal current ripple. As a result, the developed control approach substantially enhances current waveform quality while streamlining the computational implementation relative to traditional MPC techniques. The proposed strategy's effectiveness and enhanced performance characteristics are validated through comprehensive simulation analysis.
Keywords: Predictive current control, CMV suppression, multi-phase inverters, dual seven-phase topology.

Evaluation of a GWO-Based Control Algorithm for DC Motor with Load Perturbations
Phong Thanh Tran[1], Anh Tuan Huynh Nguyen[1], Ngoc Hong Nguyen[1], Hai Huu Dang[2]
[1]*Department of Physics and Computer Science, Faculty of Physics and Engineering Physics, University of Science, Vietnam National University Ho Chi Minh City, Vietnam*
[2]*Naval Technical Institute, Haiphong, Vietnam*

Abstract. Recent works have increasingly focused on intelligent and bio-inspired optimization techniques for DC motor drive applications. For example, improved WOA, Jellyfish Optimization, Gazelle Simplex, Jaya–Harmony Search, and Ant Colony Optimization have all demonstrated enhanced tuning accuracy and faster transient response for nonlinear systems. However, most reported methods focus primarily on either improving steady-state precision or boosting global search capability without validating controller robustness under dynamic load perturbations. Moreover, only a limited number of studies directly quantify how metaheuristic algorithms compare in terms of convergence stability, repeatability, and disturbance rejection when subjected to practical step-like torque variations. These gaps reveal the need for a more rigorous, comparative, and disturbance-oriented evaluation of advanced PID tuning strategies.
Keywords: DC motor; Grey wolf optimization (GWO); Intelligent motion systems; Load disturbance; PID control; Robust control; Robust speed regulation.

Influence of Sliding Surface Order on Disturbance Rejection, Stability, and Robustness in Multi-Area Smart Grids
Phong Thanh Tran[1], Tuan Van Huynh[1], Hai Huu Dang[2], Ngoc Hong Nguyen[1], Dieu Ngoc Vo[3]
[1]*Department of Physics and Computer Science, Faculty of Physics and Engineering Physics, University of Science, Vietnam National University Ho Chi Minh City, Vietnam*
[2]*Naval Technical Institute, Haiphong, Vietnam*
[3]*Department of Power Systems, Ho Chi Minh City University of Technology, Vietnam National University Ho Chi Minh City, Vietnam*

Abstract. The built-in chattering problem in traditional first-order sliding mode control (SMC) makes it very hard to use the load frequency control (LFC) of large-scale interconnected power systems. Such high-frequency oscillations not only degrade control accuracy but also accelerate actuator wear, leading to reduced system reliability. To address these challenges, this study explores the effect of sliding mode order on the dynamic stability, robustness, and disturbance rejection capability of multi-area smart grids. A second-order integral-based sliding mode controller (2O-ISMC) is created as a more advanced option to the traditional SMC framework. The proposed design effectively suppresses chattering by embedding continuous control law within an integral sliding manifold, while ensuring smooth convergence of frequency and tie-line power deviations. Simulation results on a two-area interconnected power system show that the 2O-ISMC has faster transient recovery, less overshoot, and better resistance to matched uncertainties and random load changes. These results demonstrate that in-creasing the sliding mode order notably improves disturbance rejection and overall frequency stability in modern smart grid.
Keywords: first order sliding mode control, integral sliding manifold, power system.

Design and Implementation of a Two-Wheel Legged Robot
Tan-Phi Truong Ho[1], Cuong-Quoc Lam Thai[2], and Tri-Vien Vu[3]
[1]*Graduate Student from Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*
[2]*Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, No.19 Nguyen Huu Tho Street, Tan Hung Ward, Ho Chi Minh City, Vietnam*

[3]*Modeling Evolutionary Algorithms Simulation and Artificial Intelligence, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. This work designs and implements a two-wheel legged robot (TWLR) that combines the mobility of wheeled platforms with the terrain adaptability of legged systems. The designed robot has a 5-bar linkage leg mechanism to actively adjust its height and maintain balance when encountering uneven terrain. A cascade PID structure is proposed as the main algorithm to optimize the self-balancing capability of the robot while standing and moving. To handle the system's changing dynamics a gain scheduling strategy is applied to ad-just controller parameters in real-time based on the robot's height. Furthermore, a Kalman Filter is used to estimate the system's state based on data from an IMU and multiple encoders. Extensive results from movement scenarios including self-balancing, active damping, and roll stabilization demonstrate that by using the proposed system, the robot can not only balance and move well on flat ground but also extend each leg independently to maintain body stability in complex terrain.
Keywords: Two-Wheel Legged Robot; Attitude Stability; Balance Control; PID Control; Kalman Filter.

Session B-1 – Signal Processing
Day 1 – 11 December, 2025 Thursday
Time: 10:55 ~ 12:05; Venue: Room B010
Session Chair: Prof. Roman Senkerik (Tomas Bata University in Zlin, Czech Republic)
Co-session Chair: Dr. Phan Le Son (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	10:55 ~ 11:12	**BLE beacon-based indoor localization and Voronoi diagram approach for optimal social robot positioning** Su-Jong Lim, Kyu-Young Lee, Chun-Sung Park, and Sang-Seok Yun
2	11:13 ~ 11:30	**On the Study of Mental State Recognition from Wearable EEG: Feature Analysis and Model Evaluation** Phan Le Son, Dat Tran, Duc Dam, and Lam Pham
3	11:31 ~ 11:48	**Explainable Synthetic Medical Image Generation for Enhanced Stroke Diagnosis: Combining Advanced Diffusion Models with Multimodal Interpretable AI** Divya Sahgal, Roman Senkerik and Zuzana Kominkova Oplatkova
4	11:48 ~ 12:05	**Extended Frequency-Domain Analysis of Human Movement Recognition using Multi-Input Deep Neural Networks** Michael Machů, Ivan Zelinka
12:05 ~ 13:40		Lunch

BLE beacon-based indoor localization and Voronoi diagram approach for optimal social robot positioning
Su-Jong Lim[1], Kyu-Young Lee[1], Chun-Sung Park[1], and Sang-Seok Yun[2]
[1]*Field Robotics Division, Clobot, Seongnam-si, South Korea*
[2]*Department of Mechanical Engineering, Silla University, Busan, South Korea*

Abstract. Location-aware technology is increasingly being applied to various forms of human-robot interaction to provide enhanced convenience to humans. In this paper, we propose a systematic methodology for estimating the optimal position of a social service robot to interact with a remote user located outside the robot's direct sensing area in indoor environments. Our approach consists of two main stages: First, we apply distance conversion processing and trilateration techniques to BLE (Bluetooth Low Energy) beacon-tag modules to estimate user location, with temporal confidence reasoning as post-processing to improve positioning precision. Second, to calculate the robot's optimal position for location-based service (LBS) delivery while maintaining appropriate social distance from the user, we extract the robot's navigable area from obstacle information based on grid maps and laser scans. By applying Voronoi diagram thinning to the movable area and calculating the minimum Euclidean distance to the user, we estimate the optimal position that the robot can safely reach. Finally, we validate that the service robot can perform LBS while maintaining appropriate social distance through destination movement experiments on an actual robot platform in café and hospital ward environments.
Keywords: Human-robot interaction, Location-based service, Indoor positioning, BLE beacon, Voronoi diagram

On the Study of Mental State Recognition from Wearable EEG: Feature Analysis and Model Evaluation
Phan Le Son[1], Dat Tran[2], Duc Dam[3], and Lam Pham[4]
[1]*Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Vietnam*
[2]*FPT University, Vietnam*
[3]*University of Kaiserslautern-Landau, Germany*
[4]*Laboratory for Artificial Intelligence, Institute for Computational Science and Artificial Intelligence, Van Lang University, Ho Chi Minh City, Vietnam*
Faculty of Information Technology, Van Lang School of Technology, Van Lang University, Ho Chi Minh City, Vietnam
Center for Digital Safety Security, Austrian Institute of Technology (AIT), Austria

Abstract. Wearable electroencephalography (EEG) devices enable continuous and non-invasive monitoring of brain activity in real-world environments. However, the limited number of channels, the use of dry electrodes, and

susceptibility to motion and environmental noise pose major challenges for reliable mental state recognition. This paper provides a comprehensive analysis of engineering features and model comparison to classify mental states, specifically 'Focus', 'Unfocus', and 'Relaxation' conditions, from a wearable EEG dataset. In particular, we systematically examine statistical and spectral features to identify those most informative to discriminate between cognitive states. Then, multiple machine learning models, including traditional machine learning and deep neural networks, are evaluated under session-dependent, session-independent, and subject-independent protocols. Experimental results reveal that high detection performance can be achieved even with a few EEG channels.
Keywords: EEG, Focus Detection, Brain–Computer Interface.

Explainable Synthetic Medical Image Generation for Enhanced Stroke Diagnosis: Combining Advanced Diffusion Models with Multimodal Interpretable AI

Divya Sahgal[1], Roman Senkerik[1], and Zuzana Kominkova Oplatkova[1]
[1]*Tomas Bata University Zlin, Faculty of Applied Informatics, A.I.Lab Nad Stráněmi 4511,76005, Zlin, Czech Republic*

Abstract. The critical shortage of diverse, high-quality medical imaging datasets significantly impedes the development of clinically robust AI diagnostic systems, particularly for acute stroke diagnosis where timely and precise detection directly impacts patient outcomes. This study presents a framework that synergistically combines diffusion transformers with advanced, interpretable AI methodologies to generate clinically validated synthetic medical images for enhancing stroke diagnosis. Our architecture integrates Denoising Diffusion Probabilistic Models (DDPM) with transformer-based attention mechanisms, conditional generation capabilities, and novel medical-specific loss functions tailored for neuroimaging applications. We are introducing the Medical Diffusion Transformer (Med-DiT). The overall framework incorporates a comprehensive suite of explainability techniques, including SHAP-XL, LIME-Medical, Grad-CAM++, and novel attention-based interpretability methods to ensure clinical transparency and regulatory compliance. An evaluation on a diverse, multi-center dataset of 2,000 stroke cases from five international medical institutions demonstrates great performance with Fréchet Inception Distance (FID) scores of 23.45 versus 31.78 for baseline GANs (representing significant improvement), improved Inception Score (IS), and remarkable diagnostic accuracy preservation of 94.2% for synthetic-only training. Most significantly, combined real and synthetic data training achieved 96.8% diagnostic accuracy with enhanced generalizability across diverse patient populations. Multimodal interpretability analysis, conducted using our integrated XAI framework, revealed consistent patterns. Our framework successfully generates clinically indistinguishable synthetic medical images while maintaining full interpretability and regulatory compliance, providing a transformative solution for augmenting medical imaging datasets in resource-constrained healthcare environments worldwide.
Keywords: Clinical AI validation, Diffusion transformers, Explainable artificial intelligence, Healthcare technology, Interpretable deep learning, Medical image synthesis, Stroke neuroimaging, Synthetic data augmentation.

Extended Frequency-Domain Analysis of Human Movement Recognition using Multi-Input Deep Neural Networks

Michael Machů[1], Ivan Zelinka[1]
[1]*Department of Computer Science, Faculty of Electrical Engineering and Computer Science, VSB – Technical University of Ostrava, Ostrava, Czech Republic*

Abstract. The critical shortage of diverse, high-quality medical imaging datasets significantly impedes the development of clinically robust AI diagnostic systems, particularly for acute stroke diagnosis where timely and precise detection directly impacts patient outcomes. This study presents a framework that synergistically combines diffusion transformers with advanced, interpretable AI methodologies to generate clinically validated synthetic medical images for enhancing stroke diagnosis. Our architecture integrates Denoising Diffusion Probabilistic Models (DDPM) with transformer-based attention mechanisms, conditional generation capabilities, and novel medical-specific loss functions tailored for neuroimaging applications. We are introducing the Medical Diffusion Transformer (Med-DiT). The overall framework incorporates a comprehensive suite of explainability techniques, including SHAP-XL, LIME-Medical, Grad-CAM++, and novel attention-based interpretability methods to ensure clinical transparency and regulatory compliance. An evaluation on a diverse, multi-center dataset of 2,000 stroke cases from five international medical institutions demonstrates great performance with Fréchet Inception Distance

(FID) scores of 23.45 versus 31.78 for baseline GANs (representing significant improvement), improved Inception Score (IS), and remarkable diagnostic accuracy preservation of 94.2% for synthetic-only training. Most significantly, combined real and synthetic data training achieved 96.8% diagnostic accuracy with enhanced generalizability across diverse patient populations. Multimodal interpretability analysis, conducted using our integrated XAI framework, revealed consistent patterns. Our framework successfully generates clinically indistinguishable synthetic medical images while maintaining full interpretability and regulatory compliance, providing a transformative solution for augmenting medical imaging datasets in resource-constrained healthcare environments worldwide.
Keywords: Clinical AI validation, Diffusion transformers, Explainable artificial intelligence, Healthcare technology, Interpretable deep learning, Medical image synthesis, Stroke neuroimaging, Synthetic data augmentation.

Session B-2 – Power Systems 1
Day 1 – 11 December, 2025 Thursday
Time: 14:35 ~ 16:05; Venue: Room B010
Session Chair: Dr. Chung-Li Dong (Tamkang University, Taiwan)
Co-session Chair: Dr. Pham Huu Ly (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	14:35 ~ 14:52	**Optimal solution search to the power flow problem of transmission power grids considering FACTS devices** Hung Duc Nguyen, Ly Huu Pham, Nhat Thanh Lam Uy Bui, Ba Van Vo, and Hien Thi Nguyen
2	14:53 ~ 15:10	**A Survey and Risk Assessment of Power Plant Maintenance Using the RCM - FMECA - NPR Framework** Huan Tuong Le, Tai Thanh Phan, Bach Hoang Dinh, Khoa Dang Tran Phan, Anh Quoc Doan Nguyen, Tuan Anh Tran, Phuc Hoang Nguyen, Han Gia Ngoc Phan
3	15:11 ~ 15:28	**Synchrotron X-ray Spectroscopies for Advancing Sustainable Energy Research** Chung-Li Dong
4	15:29 ~ 15:46	**Optimal Installation and Operation of Battery Energy Storage Systems in Distribution Networks Using Newton-Raphson-Based Optimizer** Hung Duc Nguyen, Huy Dong Ho, Khoi Trong Than, Khoa Hoang Truong
5	15:47 ~ 16:05	**Output Optimization for AC-DC Matrix Converter based Improved Model Predictive Vector Control Strategy** Hoang-Long Dang, Huynh-Duc Le, and Tan Luong Van
16:05 ~ 16:20		Coffee Break – Poster session

Optimal solution search to the power flow problem of transmission power grids considering FACTS devices

Duc Nguyen[1,2], Ly Huu Pham[3], Nhat Thanh Lam Uy Bui[4], and Ba Van Vo[5]
[1]*Department of Power Delivery, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, District 10, Ho Chi Minh City, Vietnam*
[2]*Vietnam National University Ho Chi Minh City, Linh Trung Ward, Thu Duc City, Ho Chi Minh City, Vietnam*
[3]*Power System Optimization Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*
[4]*Independent researcher, Tan Thuan Ward, Ho Chi Minh City, Vietnam*
[5]*Independent researcher, Saigon Ward, Ho Chi Minh City, Vietnam*

Abstract. The study employs the War Strategy Optimization Algorithm (WSO) and Mirage Search Optimization (MSO) to solve Optimal Power Loss (OPF) problem, specifically focusing the mitigation of active power losses within a transmission system. Three study cases are implemented by WSO and MSO, including Case 1) find solutions without Thyristor Controlled Series Compensator (TCSC) installed; Case 2) find solutions with 1 TCSC installed; Case 3) find solutions with 2 TCSC installed. Comparative analysis across 50 independent simulation runs consistently demonstrated the superior optimization efficacy of WSO over MSO in all scenarios, yielding quantifiable reductions in power loss of 1.255, 0.817, and 1.302 MW, respectively. The two algorithms can find the smallest loss for Case 3 and the highest loss for Case 1 among the 3 cases. So, the use of installing 2 TCSC is better than the cases without them or only one TCSC, and WSO is suitable for solving OPF problems and optimizing power loss on transmission lines.
Keywords: War Strategy Optimization Algorithm, Mirage Search Optimization, FACTS Device.

A Survey and Risk Assessment of Power Plant Maintenance Using the RCM - FMECA - NPR Framework

Huan Tuong Le[1], Tai Thanh Phan[2], Bach Hoang Dinh[2], Khoa Dang Tran Phan[1], Anh Quoc Doan Nguyen[2], Tuan Anh Tran[1], Phuc Hoang Nguyen[1], Han Gia Ngoc Phan[1]

[1]*Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*
[2]*Power System Optimization Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. This paper proposes an integrated risk-based maintenance framework for hydroelectric power plants by combining Reliability-Centered Maintenance (RCM), Failure Modes, Effects, and Criticality Analysis (FMECA), and the Number of Priority Risk (NPR) index. The approach aims to identify, quantify, and prioritize critical subsystems and failure modes to enhance operational reliability for a hydroelectric power plant. Results show that turbine-related sub-systems, particularly measurement & control, regulation, and lubrication, have the highest NPR values, accounting for the majority of financial and operational losses. The proposed methodology provides a systematic foundation for prioritizing maintenance, optimizing resources, and preventing incidents. This research helps determine maintenance priorities, optimize resources, and prevent incidents by applying the Number of Priority Risk (NPR) analysis, contributing to the development of predictive maintenance strategies to minimize incident rates and ensure safe power plant operations for hydropower plants.
Keywords: Risk Assessment, Power Plant Maintenance, NPR Framework.

Synchrotron X-ray Spectroscopies for Advancing Sustainable Energy Research
Chung-Li Dong[1]
[1]*Department of Physics, Tamkang University, Tamsui 25137, Taiwan*

Abstract. The global drive toward sustainable and carbon-neutral energy continues to accelerate progress in material science. Achieving a net-zero future depends on the discovery and development of advanced renewable energy materials through integrated, multidisciplinary research. A central challenge is to improve the efficiency of energy conversion, storage, and conservation by designing materials with optimized atomic and electronic structures. As these structures fundamentally determine material physiochemical properties, understanding their behavior, especially under realistic operating conditions, is essential for rational design and practical implementation. Synchrotron-based x-ray spectroscopies, including x-ray absorption and emission spectroscopy (XAS-XES), provide direct insight into local atomic and electronic structures. In situ techniques allow real-time observation of structural and electronic changes during operation. Scanning transmission x-ray microscopy (STXM), which combines spectroscopy with nanoscale spatial resolution, further facilitates the study of local atomic/electronic and chemical process relevant to energy materials. This presentation will discuss the use of x-ray spectroscopies to investigate atomic and electronic structures in functional materials such as nanocatalysts and smart materials. It will also summarize recent advances in in situ characterization and experimental methodologies, and introduce the Tamkang University (TKU) end-stations at the Taiwan Photon Source 45A and 27A beamlines, developed for advanced studies of energy-related materials.
Keywords: Spectroscopy, X-ray, Synchrotron-based, net-zero.

Optimal Installation and Operation of Battery Energy Storage Systems in Distribution Networks Using Newton-Raphson-Based Optimizer
Hung Duc Nguyen[1,2], Huy Dong Ho[1,2], Khoi Trong Than[1,2], Khoa Hoang Truong[1,2]
[1]*Department of Power Delivery, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, Dien Hong Ward, Ho Chi Minh City, Vietnam*
[2]*Viet Nam National University Ho Chi Minh City, Linh Xuan Ward, Ho Chi Minh City, Vietnam*

Abstract. This study proposes an optimization method for determining the optimal placement and operational strategy of Battery Energy Storage Systems (BESS) using the Newton-Raphson-Based Optimizer (NRBO) – an advanced metaheuristics algorithm designed to maximize the benefits of BESS in Radial Distribution Systems (RDS) integrated with Distributed Generation (DG). NRBO operates based on two key mechanisms: the Newton-Raphson Search Rule (NRSR), which applies the Newton-Raphson method to improve the exploration capability of the search space and accelerate convergence speed, and the Trap Avoidance Operator (TAO), which enables the algorithm to avoid local optima. The optimization objective is to minimize the total energy cost of the RDS by reducing the electricity purchased from the main substation. Simulation results demonstrate that NRBO is a viable method for reducing both energy costs and power losses in RDS integrated with DG.

Keywords: Battery Energy Storage Systems, NRBO, Optimal Installation and Operation, Energy Cost, Distributed Generation

Output Optimization for AC-DC Matrix Converter based Improved Model Predictive Vector Control Strategy

Hoang-Long Dang[1], Huynh-Duc Le[1], and Tan Luong Van[1]
[1]*Ho Chi Minh City University of Industry and Trade, Ho Chi Minh City, Viet Nam*

Abstract. This paper presents a novel control strategy for an AC-DC matrix converter, which synergistically combines model predictive control (MPC) with virtual vector (VV) concept. The primary objective of this integrated approach is to concurrently mitigate DC current ripple and ensure stable operation. The proposed methodology leverages the predictive capabilities of MPC to determine the optimal input current reference vector. Subsequently, this reference is synthesized by the VV concept to govern the converter's switching states. This hierarchical control structure guarantees high-fidelity performance at the output port. The efficacy and robustness of the proposed strategy are substantiated through comprehensive simulation validation.
Keywords: DC Current Ripple, Virtual Vector, Model Predictive Control, Matrix Converter, Output Optimization.

Session B-3 – Power Systems 2
Day 1 – 11 December, 2025 Thursday
Time: 16:20 ~ 17:50; Venue: Room B010
Session Chair: Dr. Nguyen Thanh Thuan (Industrial University of Ho Chi Minh City, Vietnam)
Co-session Chair: Dr. Nguyen Trung Thang (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	16:20 ~ 16:37	**Battery Energy Storage System Design and Operation Optimization for Minimum Energy Supplied by the Grid** Tan Minh Phan, Xuan Thuy Cao Thi, My-Ha Le, Thang Trung Nguyen, Ly Huu Pham, Hai Thanh Nguyen
2	16:38 ~ 16:55	**Investigating the effectiveness of capacitor banks and distributed generators on the real power loss index in the Vietnam distribution power grid using the Starfish optimization algorithm** Minh Phuc Duong, Dao Trong Tran, Phu Trieu Ha, Sang Dang Ho
3	16:56 ~ 17:13	**Optimal Diesel Generator Scheduling in a Grid Connected PV–WT–DG Microgrid Using the Secretary Bird Optimization Algorithm** Thach Chi Phan, Thuan Thanh Nguyen, and Thang Trung Nguyen
4	17:14 ~ 17:31	**A PSO-Enhanced Rotor Flux MRAS for Sensorless Speed Control of Induction Motor Drives** Sang Dang Ho, Cuong Dinh Tran, Tai Thanh Phan
5	17:32 ~ 17:50	**Load Frequency Control for Power Systems Integrated with Solar Power** De Huynh Tan, Bach Dinh Hoang, Van Van Huynh

Battery Energy Storage System Design and Operation Optimization for Minimum Energy Supplied by the Grid
Tan Minh Phan[1,2], Xuan Thuy Cao Thi, My-Ha Le[1,2], Thang Trung Nguyen[2], Ly Huu Pham[2], Hai Thanh Nguyen
[1]*Faculty of Electrical and Electronics Engineering, Ho Chi Minh City University of Technology and Education, Ho Chi Minh City, Vietnam*
[2]*Power System Optimization Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. The study presents an application of a battery energy storage system (BESS) for a small load within tens of kilowatt-hours to minimize the energy supplied by the grid. The load can be supplied by the grid and photovoltaic (PV) arrays, resulting in the cultivation of solar power when the load is smaller than the generation of PV arrays. The BESS can store energy and supply the energy to the load to reduce the power supplied by the grid. However, the selection of the capacity and power of the BESS is very important. A solar profile within one year in a practical zone in Vietnam is collected by using the solar global atlas. In addition, a load curve within twenty-four hours is also employed. As a result, the study determines the BESS's most suitable capacity and power. In addition, the power supplied by the grid is minimal, and the power saved by using the BESS is maximum, leading to a high load benef.
Keywords: Load Demand, Photovoltaic system, supplied energy.

Investigating the effectiveness of capacitor banks and distributed generators on the real power loss index in the Vietnam distribution power grid using the Starfish optimization algorithm
Minh Phuc Duong[1], Dao Trong Tran[2], Phu Trieu Ha[3], Sang Dang Ho[2]
Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam
Power System Optimization Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam
[3]*Faculty of Electronics and Telecommunications, Saigon University, Vietnam*

Abstract. This study presents the application of a novel meta-heuristic algorithm called the Starfish Optimization Algorithm (SFOA) to optimize the placement of capacitor banks (CBs) and distributed generators (DGs) in a

practical distribution power grid in Vietnam with 26 nodes for real power loss reduction. CBs and DGs are separately placed on a given grid in different cases to clarify their effectiveness in reaching the best real power loss. The results throughout the two cases indicate that the placement of DGs offers a significant real power loss reduction and voltage enhancement compared to CBs. Besides, SFOA also proves itself an effective search algorithm compared to the others, such as the Greylag Goose Optimization (GGO) and Arithmetic Optimization Algorithm (AOA), in terms of the ability to reach the optimal solutions and stability through all cases.
Keywords: Total real power loss, capacitor banks, distributed generators, Starfist optimization algorithm, distribution power network.

Optimal Diesel Generator Scheduling in a Grid Connected PV–WT–DG Microgrid Using the Secretary Bird Optimization Algorithm

Thach Chi Phan[1], Thuan Thanh Nguyen[1], and Thang Trung Nguyen[2]
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Abstract. This study presents an optimal diesel generator (DG) scheduling framework for a grid-connected hybrid microgrid (MG) comprising photovoltaic (PV), wind turbine (WT), and DG units. To address the limitations of conventional rule-based dispatch under variable renewable output, the Secretary Bird Optimization Algorithm (SBOA) is employed to minimize the total daily operating and emission costs while satisfying system constraints. The proposed method is evaluated against two state-of-the-art meta-heuristic algorithms, Particle Swarm Optimization (PSO) and Gravitational Search Algorithm (GSA). Simulation results demonstrate that SBOA achieves the best overall performance, reducing DG generation from 14.5 MWh under rule-based control to 5.97 MWh and lowering DG operating and emission costs by 66% and 59%, respectively. SBOA attains the lowest total operating cost (6529.7 USD), outperforming PSO (6684.5 USD) and GSA (7475.7 USD), and exhibits stable and consistent convergence across 20 independent runs. These results confirm that SBOA provides a more effective and robust optimization strategy for MG scheduling, enabling cost-efficient, low-emission, and reliable microgrid operation.
Keywords: Economic dispatch, Emission reduction, Diesel generator scheduling, Microgrid optimization, Secretary Bird Optimization Algorithm.

A PSO-Enhanced Rotor Flux MRAS for Sensorless Speed Control of Induction Motor Drives

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Abstract. This paper presents a PSO-enhanced rotor flux Model Reference Adaptive System (MRAS) for sensorless speed control of induction motor (IM) drives under the Rotor Flux Oriented Control (RFOC) framework. In the proposed method, the conventional adaptive model and PID-M structure of the traditional RF-MRAS are replaced by a Particle Swarm Optimization (PSO)-based mechanism, enabling adaptive and optimized rotor speed estimation. MATLAB/Simulink simulations were carried out to evaluate the proposed model under various operating conditions. The results show that the PSO-MRAS provides accurate and stable speed estimation, maintaining effective tracking of the reference speed even when the rotor and stator resistances increase by 10%, whereas the conventional RF-MRAS diverges under the same conditions. These findings suggest that the PSO-MRAS is a robust and promising solution for high-performance sensorless induction motor drives where stability against parameter changes is critical.
Keywords: Induction motor (IM), Model Reference Adaptive System (MRAS), Particle Swarm Optimization (PSO), Rotor flux-oriented control (RFOC), Sensorless.

Load Frequency Control for Power Systems Integrated with Solar Power

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Abstract. This paper has introduced an integral sliding mode control to control the power system connecting two areas with hydro turbines and solar energy. The paper considers the load random conditions, power system parameter variations and solar power system disturbances. The paper has analyzed the theory and proved the stability of the system according to Lyapunov's theorem. A control law is used to ensure that the frequency deviation converges to zero, even as load demand changes or the solar power source is disturbed. The paper has also simulated for 3 cases. The simulation results in all three cases confirmed the system stability.
Keywords: Load frequency control, sliding mode control, solar power, two-area power system.

Session C-1 – Mechatronics
Day 1 – 11 December, 2025 Thursday
Time: 10:55 ~ 12:05; Venue: Room C010
Session Chair: Dr. Dae-Hwan Kim (SUNY, Korea)
Co-session Chair: Dr. Nguyen Hoang Nam (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	10:55 ~ 11:12	**L1 Adaptive-Decoupled Control for Roll Regulation in Contra-Rotating Propeller Systems** Quoc Thai Lam Cuong, Uyen Phuong Pham, Van Tu Duong, Huy Hung Nguyen, and Tan Tien Nguyen
2	11:13 ~ 11:30	**A Vision Transformer Framework for Robust Visual Localization** Dae Hwan Kim, Sung Jun Park
3	11:31 ~ 11:48	**Vision-Guided Restacking for Crane Automation** Le-Quang-Nhat Hoang, Phat-Thinh Nguyen
4	11:48 ~ 12:05	**Smart Beam Modulation for Adaptive Automotive Head Light Systems** Isuru Lakmal, Sandun Adikari, Pasan Madhuranga
12:05 ~ 13:40		Lunch

$\mathcal{L}_1$ Adaptive-Decoupled Control for Roll Regulation in Contra-Rotating Propeller Systems

Quoc Thai Lam Cuong[1,2,3], Uyen Phuong Pham[1,2], Van Tu Duong[1,2], Huy Hung Nguyen[4], and Tan Tien Nguyen[1,2]
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Abstract. This paper presents a roll regulation strategy based on $\mathcal{L}1$ adaptive control, aiming to achieve the desired surge velocity while stabilizing the roll angle at its equilibrium position. A feedback-based approach is employed to couple the strong nonlinear dynamics of surge velocity and roll by introducing virtual control inputs. These virtual controllers are designed using a baseline PID controller combined with $\mathcal{L}1$ adaptation law to mitigate external disturbances such as ocean waves and currents, as well as internal uncertainties arising from temperature variations. The effectiveness of the proposed method is demonstrated through comparative simulations with a conventional PID controller, showing that both the surge velocity response and roll angle stabilization achieve better performance in terms of mean absolute error (MAE), although the system initially exhibits slower convergence due to the adaptation process.

Keywords: $\mathcal{L}1$ adaptive control, Decoupled control, Roll regulation, Contra rotating propeller

A Vision Transformer Framework for Robust Visual Localization

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Abstract. Visual camera localization aims to estimate the six-degree-of-freedom(6-DoF) camera pose from a given query image, which is a fundamental problem in computer vision and robotics. In this paper, we present a self-attention-driven deep learning framework for indoor visual localization, designed to enhance both accuracy and generalization. Our model leverages deep spatial point representations extracted from low-level feature maps to precisely learn the scene coordinate regression. By integrating multi-scale contextual features and attention-based feature aggregation, the proposed method effectively captures in variant and discriminative visual cues across

different feature hierarchies. Furthermore, a robust end-to-end training pipeline is implemented, enabling direct supervision from ground-truth poses and improving pose estimation stability. Extensive experiments on the 7-Scenes indoor benchmark demonstrate that our approach achieves state-of-the-art or comparable performance while maintaining efficiency and robustness across divers indoor scenes.
Keywords: Camera Relocalization, Multi-Scale Feature Learning, Indoor Localization, Self-Attention.

Vision-Guided Restacking for Crane Automation
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Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, 19 Nguyen Huu Tho St., Tan Hung, Ho Chi Minh City, Vietnam

Abstract. Container handling at modern terminals increasingly requires automation to improve throughput without compromising safety. This paper presents the design and validation of a vision-guided, PC-centric quay gantry crane (STS) testbed that performs end-to-end autonomous pick-and-place of container mock-ups. The prototype reproduces the principal STS motions and integrates a rigidly mounted trolley camera, YOLOv8 detection, and a calibrated pixel-to-motion map that yields target setpoints (Xref, Yref) for the trolley and hoist; near-goal actions are gated by a K-frame stability check, while a priority-based restacking policy (empty → fewer → nearer) resolves occlusions. A unified coding of deck rows, yard positions, and truck bays enables import/export workflows in both Manual and Auto modes, with an ESP32 handling low-level I/O and continuous telemetry. Experiments on the stepper-driven rig demonstrate reliable detection, smooth motion, and accurate placement without operator intervention; the interface provides inventory counting, input validation, and an Emergency Stop for safety. These results confirm the feasibility of applying vision and embedded control to automate STS-like operations at lab scale and establish a practical research platform for advancing planning, sensing, and control toward port-grade deployment.
Keywords: Crane control; vision-guided; smart harbor.

Smart Beam Modulation for Adaptive Automotive Head Light Systems
Isuru Lakmal[1], Sandun Adikari[1], Pasan Madhuranga[2]
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[2]*University of Sri Jayawardhanapura, Sri Lanka*

Abstract. Driving at night poses significant challenges, especially when visibility is compromised by glare from oncoming or trailing headlights. This research presents an intelligent adaptive headlamp system utilizing LED matrix technology to dynamically control individual LEDs based on real-time driving conditions. The system aims to enhance nighttime driving safety and comfort by optimizing road illumination for the driver while actively reducing glare for other road users. By integrating stereo vision cameras, smart controllers, and advanced algorithms, the proposed solution marks a substantial improvement over traditional fixed-beam headlights. A functional prototype was developed and subjected to controlled testing to validate its performance. The system's core objective is to enable real-time beam modulation that preserves forward visibility and minimizes visual disturbance for oncoming traffic, thereby reducing the risk of nighttime and adverse-weather collisions.
Keywords: Adaptive Lighting, Automated Headlights, Automotive Headlights, Driver Safety, LED Matrix, Smart Controllers.

Session C-2 – Wireless Technologies 1
Day 1 – 11 December, 2025 Thursday
Time: 14:35 ~ 16:05; Venue: Room C010
Session Chair: Assoc. Prof. Tran Trung Duy (Posts and Telecommunications Institute of Technology, Vietnam)
Co-session Chair: Assoc. Prof. Nguyen Nhat Tan (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	14:35 ~ 14:52	**SER Analysis in Energy Harvesting Relaying Networks with Partial Relay Selection** Lam Dong Huynh, Radim Burget, Lam-Thanh Tu, and Tan N. Nguyen
2	14:53 ~ 15:10	**BER Analysis of SWIPT-Aided Cooperative Relaying Systems Under Various Diversity** Thu-Quyen Thi Nguyen, Tan N. Nguyen, Lam-Thanh Tu, and Phu Si Le
3	15:11 ~ 15:28	**Outage Performance Evaluation of Fountain Code-Aided Two-Way Relay Networks with Analog Network Coding and Partial Relay Selection** Nguyen Thi Hau, Pham Minh Nam, Nguyen Lan Anh, Tran Trung Duy
4	15:29 ~ 15:46	**A Broadband Dual-band Antenna for LTE and WLAN Applications** Ngoc-Lan Nguyen
5	15:47 ~ 16:05	**A Broadband Circularly Polarized Crossed-Dipole Antenna for WLAN Applications** Ngoc-Lan Nguyen, Tran Dinh Dat, Pham Xuan Minh, Pham Gia Hieu, and Nguyen Chi Bao
16:05 ~ 16:20		Coffee Break – Poster session

SER Analysis in Energy Harvesting Relaying Networks with Partial Relay Selection
Lam Dong Huynh[1], Radim Burget[2], Lam-Thanh Tu[3], and Tan N. Nguyen[3]
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[3]*Communication and Signal Processing Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. This paper presents a comprehensive investigation into the performance of a dual-hop cooperative relaying network, where energy constrained relays use a power-switching (PS) protocol for radio frequency (RF) energy harvesting. To enhance system performance, we implement a partial relay selection (PRS) scheme to harness user diversity and employ maximum ratio combining (MRC) at a multi-antenna destination to capitalize on spatial diversity. The principal contribution of this study is the derivation of an exact closed-form analytical expression for the end-to-end Symbol Error Rate (SER) over Rayleigh fading channels. The accuracy of this expression is corroborated through extensive Monte-Carlo simulations, which demonstrate perfect alignment with the analytical results. Additionally, the analysis provides critical insights into system behavior by quantifying performance gains achieved by increasing the number of relays and destination antennas. Furthermore, it characterizes the fundamental trade-off between energy harvesting and information transmission, highlighting an optimal PS ratio that minimizes SER.
Keywords: Energy harvesting, partial relay selection (PRS), maximum ratio combining (MRC), power-switching (PS), symbol error rate (SER), amplify-and-forward (AF).

BER Analysis of SWIPT-Aided Cooperative Relaying Systems Under Various Diversity
Thu-Quyen Thi Nguyen[1], Tan N. Nguyen[2], Lam-Thanh Tu[2], and Phu Si Le[3]
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[2]*Advanced Intelligent Technology Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

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Abstract. This paper investigates a cooperative AF relay network with simultaneous wireless information and power transfer (SWIPT), where the relay employs a power splitting (PS) protocol to harvest energy and forward information. At the destination, multiple antennas with maximal ratio combining (MRC) and selection combining (SC) are applied to improve detection reliability. System performance is analyzed in terms of bit error rate (BER) and validated via Monte Carlo simulations. The impact of key parameters such as the power splitting ratio, modulation schemes, and energy harvesting efficiency is examined, providing design insights for energy-constrained cooperative networks.
Keywords: simultaneous wireless information and power transfer (SWIPT), amplify-and-forward (AF), energy harvesting (EH), bit error rate (BER).

Outage Performance Evaluation of Fountain Code-Aided Two-Way Relay Networks with Analog Network Coding and Partial Relay Selection

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[2]*Faculty of Engineering and Technology, Saigon University, Ho Chi Minh City, Vietnam*
[3]*Posts and Telecommunications Institute of Technology, Ho Chi Minh City, Vietnam*

Abstract. This paper evaluates outage performance of Fountain Code (FC)-aided two-way relay networks (TWRNs) employing analog network coding (ANC). In the proposed scheme, two source nodes exchange Fountain-coded packets (FC-Ps) with each other via one of amplify-and-forward (AF) relays that is selected based on a partial relay selection (PRS) method. In the first time slot, both sources simultaneously transmit the modulated signals of their FC-Ps to the selected relay. In the second time slot, the relay forwards the received signals to both sources using the AF protocol. Exact closed-form expressions of outage probability (OP) at each source of the proposed scheme over Rayleigh fading channels are derived. Unlike previous works, this paper considers block fading channels, where the channel coefficients remain constant during one FC-P exchange cycle and change independently after each cycle. The OP formulas are verified by Monte Carlo simulations. Furthermore, the OP performance of the proposed scheme is compared with that of the corresponding TWRNs employing digital network coding (DNC). The numerical results reveal that the proposed scheme achieves significantly lower OP than the corresponding DNC-based TWRNs, highlighting the benefits of jointly applying FC, ANC, and PRS.
Keywords: Analog network coding, Fountain codes, outage probability, partial relay selection, two-way relay networks.

A Broadband Dual-band Antenna for LTE and WLAN Applications

Ngoc-Lan Nguyen[1]
[1]*Wireless Communication Laboratory, Posts and Telecommunications Institute of Technology, Ho Chi Minh City, Vietnam*

Abstract. In this work, a dual-band antenna with the characteristic of broadband operation is introduced for LTE and WLAN systems at 2.6 GHz and 5.8 GHz. The design consists of four microstrip patch elements arranged in a 2 × 2 configuration, where two patch sizes are designed to support resonance at the two operating bands. A T-junction power divider is employed to distribute the signal across the array. By combining a partial ground layout with an Artificial Magnetic Conductor (AMC) surface, both the bandwidth percentage and the overall radiation efficiency are noticeably improved. Simulation results show that the antenna maintains impedance matching under -10 dB and a high gain throughout both bands. The achieved −10 dB impedance bandwidths are 24.2% for the lower band and 20% for the upper band, while the corresponding peak gains reach 9.2 dBi and 10.5 dBi.
Keywords: Dual-band antenna, Long-term evolution, Microstrip antenna, Wireless local area network.

A Broadband Circularly Polarized Crossed-Dipole Antenna for WLAN Applications

Ngoc-Lan Nguyen[1], Tran Dinh Dat[2], Pham Xuan Minh[2], Pham Gia Hieu[3], and Nguyen Chi Bao[3]
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[3]*Student at Posts and Telecommunications Institute of Technology, Ho Chi Minh City, Vietnam*

Abstract. This paper introduces a circularly polarized crossed-dipole antenna that achieves both wideband performance and high gain. The proposed design employs a multilayer cavity structure, which not only enhances gain, but also improves the impedance matching for the antenna. Consequently, the antenna demonstrates considerable enhancements in impedance bandwidth and radiation gain. Circular polarization is realized through the excitation of two orthogonal dipole elements with equal amplitude and a 90° phase difference. The final design exhibits an overall dimension of 86.2 × 86.2 × 32, a −10 dB impedance bandwidth of 12% (5.28–5.93 GHz), and a peak gain of 8.3 dBi. Furthermore, the antenna maintains a radiation efficiency exceeding 96% across the entire operating band.
Keywords: Crossed dipole, multilayer cavity, circular polarization antenna, WLAN.

Session C-2 – Wireless Technologies 2
Day 1 – 11 December, 2025 Thursday
Time: 16:20 ~ 17:40; Venue: Room C010
Session Chair: Dr. Anh Le-Thi (Hanoi University of Industry, Vietnam)
Co-session Chair: Dr. Lam-Thanh Tu (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	16:20 ~ 16:37	**Outage Probability of Active RIS-Aided Wireless Communications: Analysis and Simulation** Thien Nguyen, Lam-Thanh Tu, Ngo Minh Dat, Vo Tan Thanh, Phuong T. Tran
2	16:38 ~ 16:55	**Unified Performance Analysis of Satellite-Terrestrial Partial NOMA Systems** Nhat-Truong Thanh Nguyen, Nguyen Ngoc Phuong Thanh, Nguyen Ngoc Thuy Trang, and Hong-Nhu Nguyen
3	16:56 ~ 17:13	**A DDQN-Based Joint Resource Allocation and Phase-Shift Optimization for Capacity and Energy Efficiency Enhancement in IRS-Aided UAV-RSMA Networks** Anh Le-Thi, Hieu Tran-Quang, Phuoc Nguyen-Van, Sang Nguyen-Quang, and Hong Nguyen Thi
4	17:14 ~ 17:31	**A hybrid Two-Stage Heterogeneous-Data IDS Framework for IoT Networks Using LightGBM and EfficientNetB7** Nien Nguyen-Manh, Nha Tran-Van, Sang The-Nguyen, Loi Nguyen-Tien, and Anh Le-Thi
5	17:32 ~ 17:50	**An Optimal Approach to SNR Calculation in FSO Channels under Strong Atmospheric Noise Based on Receiver Mirror Diameter** Cuu Ho Van, Nhat-Tien Nguyen, and Anh Dinh Thi Lan

Outage Probability of Active RIS-Aided Wireless Communications: Analysis and Simulation
Thien Nguyen[1], Lam-Thanh Tu[2], Ngo Minh Dat[1], Vo Tan Thanh[1], Phuong T. Tran[3]
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[3]*Wireless Communications Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. Reconfigurable Intelligent Surfaces (RIS) have emerged as a key enabler for next-generation wireless communication systems because of their ability to flexibly manipulate wireless signals. This paper examines the performance of RIS-assisted wireless communication systems, where active elements are utilized to mitigate the inherent double-fading effect in Rayleigh channels. By modeling the signal-to-noise ratio (SNR), we derive a closed-form expression for the outage probability (OP). The results of the Monte Carlo simulation by using MATLAB are shown to be in close agreement with the theoretical analysis, thereby demonstrating the potential of active RIS to enhance link reliability in environments of severe fading.
Keywords: Active RIS, Gamma approximation, Monte Carlo simulation, outage probability, Rayleigh channel

Unified Performance Analysis of Satellite-Terrestrial Partial NOMA Systems
Nhat-Truong Thanh Nguyen[1], Nguyen Ngoc Phuong Thanh[2], Nguyen Ngoc Thuy Trang[2], and Hong-Nhu Nguyen[2]
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Abstract. This paper presents a comprehensive performance analysis of a satellite-ground network utilizing Partial Non-Orthogonal Multiple Access (PNOMA) for enhancing spectrum efficiency and user fairness. The system in focus comprises a multi-antenna satellite serving two ground users in a hybrid OMA/NOMA system. Particularly, exact closed-form expressions of some performance metrics, such as outage probability, asymptotic regime, and throughput, are derived in the context of the shadowed-Rician fading channel. These models capture the statistical richness of the fading channels, involving special functions such as the Beta and lower incomplete Gamma functions. The analytical results are verified through Monte Carlo simulations, providing valuable insights into system behavior, including power allocation effects, user positions, and antenna configurations. The new framework provides valuable information for designing and evaluating future satellite-augmented 6G communication systems.
Keywords: Outage probability, Partial NOMA, Satellite-terrestrial networks, Shadowed-Rician fading, Throughput analysis

A DDQN-Based Joint Resource Allocation and Phase-Shift Optimization for Capacity and Energy Efficiency Enhancement in IRS-Aided UAV-RSMA Networks

Anh Le-Thi[1], Hieu Tran-Quang[1], Phuoc Nguyen-Van[1], Sang Nguyen-Quang[2], and Hong Nguyen Thi[2]
[1]*School of Information and Communication Technology Hanoi University of Industry, Vietnam*
[2]*Posts and Telecommunications Institute of Technology, Vietnam*

Abstract. In this paper, we propose and examine an intelligent reflecting surface (IRS)-aided unmanned aerial vehicle (UAV) communication system employing rate-splitting multiple access (RSMA), in which a ground base station (GBS) communicates with multiple users via a UAV equipped with an IRS. In order to improve both the sum channel capacity and the overall energy efficiency of the network, we design a double Deep Q-Learning-based optimization mechanism (DDQN) that autonomously derives the optimal configuration policy through iterative interaction with the communication environment. The proposed approach jointly optimizes the UAV's position, phase-shift of IRS, and RSMA power-splitting coefficients to improve capacity and energy efficiency. Furthermore, we evaluated the influence of key system parameters on both SCC and EE, including the GBS's transmitted power, the number of IRS elements, the hovering height, and the UAV's horizontal position. In addition, we performed simulations to compare the proposed DDQN-based scheme with the baseline scheme- the conventional DQN algorithm. These findings highlight the potential of combining IRS, UAV mobility, and RSMA with deep reinforcement learning to achieve highly efficient, adaptive 6G wireless networks.
Keywords: Double Deep Q learning, IRS-aid UAV, RSMA, Sum of channel capacity, and Energy Efficiency

A hybrid Two-Stage Heterogeneous-Data IDS Framework for IoT Networks Using LightGBM and EfficientNetB7

Nien Nguyen-Manh[1], Nha Tran-Van[1], Sang The-Nguyen[1], Loi Nguyen-Tien[1], and Anh Le-Thi[1]
[1]*School of Information and Communication Technology Hanoi University of Industry, Vietnam*

Abstract. The Internet of Things (IoT) networks have become increasingly susceptible to cyber threats due to the proliferation of resource constrained devices and inherent security vulnerabilities. To enhance the security and robustness of IoT networks, we propose a multi-level Intrusion Detection System (IDS) that leverages both machine learning and deep learning in this study. There are two stages of framework operations: the first stage performs a binary classification of network traffic using a tuned Light Gradient Boosting Machine (LightGBM) model optimized to minimize false negatives, thereby reducing the risk of undetected intrusions. The second stage further analyzes the suspicious traffic identified by Stage 1 using an FT-Transformer deep learning model to conduct fine-grained multi-class classification of specific attack categories, including DoS, DDoS, port scanning, and other intrusions. The training dataset is constructed by preprocessing and integrating three publicly available benchmark datasets—ToN-IoT, NetFlow v3, and UNSW NB15—covering a comprehensive range of IoT attack scenarios. The experiments show that the proposed two-level IDS achieves 99.89% recall with very low false negatives at Level 1 and about 97% accuracy at Level 2, highlighting its balanced effectiveness in detecting and classifying IoT attacks.
Keywords: EfficientNetB7, Heterogeneous-Datasets, IoT, LightGBM, and Two-Stage Hybrid Framework

An Optimal Approach to SNR Calculation in FSO Channels under Strong Atmospheric Noise Based on Receiver Mirror Diameter

Cuu Ho Van[1], Nhat-Tien Nguyen[1], and Anh Dinh Thi Lan[1]
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Abstract. In free-space optical (FSO) communication channels, strong atmospheric turbulence causes significant attenuation of the received optical signal. Increasing the diameter of the receiving mirror enhances the collection gain and improves the received signal power; however, it also leads to higher background noise from sunlight, which can reduce the overall signal-to-noise ratio (SNR). This paper proposes an optimal method to determine the SNR as a function of the receiving mirror diameter. Furthermore, a simulation model of the FSO transmission channel was developed to evaluate system performance under different mirror diameters. The results identify the optimal trade-off between mirror diameter and system performance, achieving the highest quality (Q) factor and the lowest bit error rate (BER).

Keywords: Atmospheric turbulence, BER, FSO, SNR, Q factor.

Session D-1 – Material Science
Day 1 – 11 December, 2025 Thursday
Time: 10:55 ~ 12:05; Venue: Room A403
Session Chair: Hsin-Fei Meng (National Yang Ming Chiao Tung University, Taiwan)
Co-session Chair: Dr. Gaurav Bharti (Indian Institute of Information Technology Bhopal, India)

№	Time	Paper Title
1	10:55 ~ 11:12	**Design and Development of a Smart High-Voltage Electric Field Therapy Device with Enhanced Safety Features** Thi Ngoc Anh Nguyen, Thi Bang Doan, Viet Thang Tran and Thanh Phuong Nguyen
2	11:13 ~ 11:30	**Design and Development of an Optical Programmable Interface for Fiber Bragg Grating (FBG) Sensors in a Plantar Pressure Measuring Device** Tarak Khurana, Ahmad S. Abdullah, Narottam Chaubey, Ibrar Jahan MA, Gautam Narayan Nirala, Gaurav Bharti
3	11:31 ~ 11:48	**Solar cells and gas sensors based on organic semiconductors** Hsin-Fei Meng, Yu-Chiang Chao, Hsiao-Wen Zan
4	11:48 ~ 12:05	**Synthesis and characterization of transparent conductive thin film for opto-electronic devices** Shiuan Huei Lin, Vera Marinov, Dimitrina Petrova, Dimitre Dimitrov
12:05 ~ 13:40		Lunch

Design and Development of a Smart High-Voltage Electric Field Therapy Device with Enhanced Safety Features
Thi Ngoc Anh Nguyen[1], Thi Bang Doan[2], Viet Thang Tran[3], and Thanh Phuong Nguyen[1]
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[2]*Industrial University of Ho Chi Minh City, 12 Nguyen Van Bao, Hanh Thong ward, HCMC Viet Nam*
[3]*Nguyen Tat Thanh University of Ho Chi Minh City, D2 street Long Thanh My ward, Thu Duc City, HCMC Viet Nam*

Abstract. This exploratory work focuses on research, design and experimental validation of a non-invasion physiotherapy support device by high voltage electrical field (HVEF). The device can generate a HVEF around the human body to treat musculoskeletal and neurological diseases by stimulating metabolism, improving blood circulation, regulating autonomic nerve activity, reducing inflammation and pain, and supporting the body's natural recovery process. The proposed device supplies HVEF ranging from 400 Vp to 16000 Vp with maximum current limit of 5mA to ensure patient safety; a waveform generator creates three kinds of waveforms adaptable to different therapeutic targets; and a three-level protection circuit to ensure absolute safety during use. A 7-inch touch HMI interface is designed for intuitive users, while the system connects to the IoT network, allowing remote monitoring, treatment data storage, and personalized treatments. In particular, the system is optimized for the integration of AI-based data analytics in future research to develop intelligent therapy models. The proposed design uses only commercially available off-the-shelf components, thereby reducing prototyping expenses. Initial test results demonstrate that the system operates stably, and generates accurate waveforms and voltage levels. This system creates opportunities to use domestically equipped equipment at low cost, while paving the way toward a smart digital, personalized biomedical physiotherapy platform.
Keywords: Electric field therapy, High-voltage medical device, AI, IoT-enabled healthcare, Non-invasive treatment, Personalized therapy.

Design and Development of an Optical Programmable Interface for Fiber Bragg Grating (FBG) Sensors in a Plantar Pressure Measuring Device
Tarak Khurana[1], Ahmad S. Abdullah[2], Narottam Chaubey[3], Ibrar Jahan MA[4], Gautam Narayan Nirala[5], Gaurav Bharti[6]
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Abstract. Modern systems lack in effective visualization of Plantar pressure analysis due the data complexity and inadequacy of user-friendly interfaces. This paper proposes an efficient interface for Plantar pressure analysis centered upon the principles of Fiber Bragg Grating (FBG). The device measures the variations in Bragg Wavelength at specific foot locations, while the interface converts this raw data into effective visualizations, comprising of foot diagrams and graphs for easier interpretation and analysis. This paper further classifies foot conditions, prepares a generic report, and comes with an optimized feature of report sharing. The system enhances visualization and bridges the gap between the practical clinical use and advanced sensing technologies which assists doctors to effectively utilize the plantar pressure data, further aids to better patient management.
Keywords: Braggs Wavelength, Interface, Plantar Pressure, Python Programming, Fiber Bragg Gratings.

Solar cells and gas sensors based on organic semiconductors
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Abstract. Organic solar cells have the advantages of being semi-transparent, thin, light weight, and easy in fabrication. We achieved leading efficiencies in organic solar panels on large glass substrate [1]. Because of the photochemical reactions of organic materials and the metal oxide materials, the solar cells usually decay rapidly under the solar light due to the ultraviolet irradiation. Through the ternary semiconductor blends and the low-cost UV filter, the sunlight lifetime is raised to more than 4000 hours [2]. Furthermore, through the sealing design, the lifetime of the solar cell module is raised to be similar to the small device [3]. After interface modification for metal oxide, the module can keep about 10% efficiency for long time under solar irradiation. Solar cell fabrication without any costly vacuum deposition is demonstrated using cylinder blade coating and spray coating. Greenhouse projects using transparent organic solar modules are demonstrated. The stable module is an important step for the real world evaluations of organic solar cells. For gas sensor we designed a unique sensor structure with vertical conduction channel relative to the substrate. In the way the channel length can be reduced to about 300 nm without complicated lithography. Such sensors are highly sensitive and reproducible. The sensors were successfully used to monitor the breath of kidney diseases patients [4]. It is also used to monitor the gas emission due to the bacteria [5] or fertilizer pollution. Conventionally it is slow to detect such pollutions in the water. Using the gas emission, it is much faster to obtain the pollution level in the rivers or drinking water. It was demonstrated for the rice field [6]. Such system is helpful to monitor and control the eutrophication of rivers and oceans.
Keywords: solar cell, gas sensor, pollution monitoring, eutrophication.

Synthesis and characterization of transparent conductive thin film for opto-electronic devices
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Abstract. The integration of high uniformity, conformal and compact transparent conductive layers into next generation indium tin oxide (ITO)-free optoelectronics including wearable and bendable structures is a huge challenge. In this talk, we demonstrate two kinds of transparent and conductive functionality of thin films, including Aluminum-doped zinc oxide (AZO) and graphene prepared on glass as well as on Polyethylene terephthalate (PET) flexible substrates for display devices. For graphene thin film, it was synthesized by atmospheric pressure Chemical Vapor Deposition (CVD) using Copper foil (Alfa Aeser 99.8% purity, 25 μm thickness) and transferred on substrates by PMMA (poly(methyl-methacrylate)) transfer method. We study the optical and electrical properties of grown multilayer graphene and implementation in flexible optoelectronics. For AZO thin film, it was prepared by using atomic layer deposition (ALD) technique. AZO thin films possess high

optical transmittance at visible and near-infrared spectral range and electrical properties competitive to commercial ITO layers. AZO layers deposited on flexible PET substrates demonstrate very stable sheet resistance over 1000 bending cycles. Based on the performed optical and electrical characterizations several applications of ALD AZO as transparent conductive layer are shown: AZO/Glass supported Liquid Crystal (LC) display as well as AZO/PET based flexible Polymer Dispersed Liquid Crystal (PDLC) devices. In addition, we demonstrate for the first time to the best of our knowledge a vertical orientation of the LC director achieved by controlling the crystallographic orientation of the AZO films, further enhanced by formation of nanogrooves on the film's surface by the mechanical rubbing. The electro-optical characteristics of the AZO based LC phase retarder were demonstrated. Presented results show the superior potential of AZO for integration in next-generation indium-free LC devices.
Keywords: Al-doped ZnO, graphene, transparent conductive layers, LC display, flexible PDLC devices.

Session D-2 – Industrial Session
Day 1 – 11 December, 2025 Thursday
Time: 14:35 ~ 16:05; Venue: Room A403
Session Chair: Assoc. Prof. Phuong T. Tran (Ton Duc Thang University, Vietnam)
Co-session Chair: Dr. Tran Thanh Nam (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	14:35 ~ 14:50	**Digital Eco Service Strategy for Global Technolgy Commercialization – Focusing on Domestic and International Cases** Yong-Il Lee
2	14:50 ~ 15:05	**Geoscience-Based Smart Tourism Network for the Mekong and Central Highlands: A Korea-Vietnam University Collaboration and Dual-Testbed Framework** Dao Van Tuyet, Hye Kyung Lee, Dokyong Kim, Joong Hyun Cho, Hyung Nam Kim, Le Tran Ngoc Sang, Tran Duc Dung, Phuong T. Tran
3	15:05 ~ 15:20	**TerraChar-Based IT–Agriculture Collaboration Testbed for Carbon Sequestration and Smart Farming Applications in Vietnam** Hye Kyung Lee, Phuong T. Tran, Chau Si Thien Dong, Le Ngoc Thanh, Dao Van Tuyet, Dokyong Kim, Hyung Nam Kim, Bui Quang Huy, Doan Duy Duc
4	15:20 ~ 15:35	**Smart Water Plus: Korea–Vietnam Cooperation for Advanced Water Purification and Resource Management in the Mekong Region** Hye Kyung Lee, Phuong T. Tran, Dokyong Kim, Hyung Nam Kim, Le Ngoc Thanh, Dao Van Tuyet, Le Truong Duy, Ngo Minh Dat
5	15:35 ~ 15:50	**Development of an Open Data-Based AI Learning Testbed for Medical Information Integration at Ton Duc Thang University and Mekong University** Dao Van Tuyet, Hye Kyung Lee, Dokyong Kim, Phuong T. Tran, Nguyen Dang Khoa, Hua Phu Doan, Tran Duc Dung, Hyung Nam Kim, Ngo Minh Dat
6	15:50 ~ 16:05	**Developing Smart Energy Management Solutions for Carbon Credit Enterprises in Vietnam** Vo Dinh Tung, Phuong T. Tran, Duk Yun Hwang, Dokyong Kim, Hyun Ju Na, Hyung Nam Kim, Le Nhat Huy, Ngo Minh Dat
16:05 ~ 16:20		Coffee Break – Poster session

Digital Eco Service Strategy for Global Technolgy Commercialization – Focusing on Domestic and International Cases

Yong-Il Lee[1]
[1]*AnyFive Co., Ltd., Seoul, Korea*

Abstract. This study analyzes effective Digital Eco Service Strategies crucial for globally commercializing innovative technologies in the era of Digital Transformation. We argue that companies must shift from a product-centric to a service-centric model (Digital Servitization) to ensure global scalability. The research establishes that success hinges on three core strategic components: establishing a Unified Platform (e.g., secure, cloud-based infrastructure), fostering robust Ecosystem Partnerships (for value co-creation and synergy), and ensuring Phased Service Maturity (from basic recognition to mass customization). Analysis of successful domestic and international cases (e.g., global tech platforms, smart city initiatives) highlights the pivotal role of these integrated strategies. The findings provide a comprehensive framework for companies seeking to leverage digital ecosystems to overcome geographical limitations and accelerate global market entry. Ultimately, global commercialization is achieved through operating a fully developed Digital Service Ecosystem, requiring proactive policy support for SME digital capability enhancement and partnership facilitation.

Keywords: digital servitization, digital transformation, technology transfer, ecosystem partnerships, phased service maturity.

Geoscience-Based Smart Tourism Network for the Mekong and Central Highlands: A Korea-Vietnam University Collaboration and Dual-Testbed Framework

Dao Van Tuyet[1], Hye Kyung Lee[2], Dokyong Kim[2], Joong Hyun Cho[3], Hyung Nam Kim[4], Le Tran Ngoc Sang, Tran Duc Dung[6], Phuong T. Tran[7]
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[7]*Wireless Communications Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. This paper reports a Korea-Vietnam collaboration to build a geoscience-based smart tourism network that interlinks the Mekong lowland and Central Highlands of Vietnam through ecological analytics, cultural exchange, and university-led innovation. The proposed dual-testbed framework couples a digital AI-GIS hub at Ton Duc Thang University (TDTU) with a field ecology and tourism resource hub at Đắk Nông Community College. The architecture integrates Internet-of-Things (IoT) sensing, geospatial data processing, and AI-assisted visualization on a secure cloud operated with LFO Co., Ltd., and is co-shaped with hospitality and cultural partners including Chalet Korea and KEHWA. Early integration exercises indicate improved interoperability between GIS and IoT streams, higher delineation accuracy of eco-tourism sites, and measurable gains in student engagement and cross-border program design. The platform functions as an open, education-centered data commons for sustainable tourism planning, digital content co-creation, and cross-cultural learning.
Keywords: Smart tourism, geoscience, GIS, Mekong Delta, Dak Nong highlands, eco-tourism.

TerraChar-Based IT–Agriculture Collaboration Testbed for Carbon Sequestration and Smart Farming Applications in Vietnam

Hye Kyung Lee[1], Phuong T. Tran[2], Chau Si Thien Dong[3], Le Ngoc Thanh[4], Dao Van Tuyet[5], Dokyong Kim[1], Hyung Nam Kim[6], Bui Quang Huy[3], Doan Duy Duc[3]
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Abstract. This paper introduces a Korea–Vietnam collaborative framework that integrates artificial intelligence (AI), Internet of Things (IoT), and biochar-based soil enhancement for sustainable smart farming. The project connects Ton Duc Thang University (TDTU), responsible for AI-driven data modeling and IoT analytics, with Đak Nong Community College, which conducts field experiments using TerraChar—a low-emission rice husk biochar. Supported by LFO Co., Ltd., the system employs cloud-based visualization to analyze and validate the effects of TerraChar on soil carbon sequestration, crop yield, and environmental sustainability. The results demonstrate a replicable, data-driven testbed model that links technology and agriculture, providing a pathway toward smart, carbon-efficient farming practices in Vietnam's Central Highlands.
Keywords: TerraChar, smart agriculture, artificial intelligence, carbon sequestration, IoT.

Smart Water Plus: Korea–Vietnam Cooperation for Advanced Water Purification and Resource Management in the Mekong Region

Lee Hye Kyung[1], Phuong T. Tran[2], Kim Do Kyong[3], Kim Hyung Nam[4], Le Ngoc Thanh[5], Dao Van Tuyet[6], Le Truong Duy[7], and Ngo Minh Dat[7]
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Abstract. We present the Smart Water Plus initiative, a Korea and Vietnam collaborative research program that combines TerraHeim smart purification technology, KEHWA coordination, the Ton Duc Thang University Internet of Things testbed, and independent validation by REMIT and the Institute of Life Sciences. A pilot at Ton Duc Thang University evaluates an antibiofilm Smart Water Plus system and converts both manual and sensor data into a big data resource for artificial intelligence-based prediction and filtration optimization. The study reports the system concept, the testbed methods, and initial performance indicators, and it outlines a pathway for industrial cooperation with Vietnamese purification and manufacturing enterprises. The approach is designed to deliver verifiable technical evidence that can support scale up and market adoption in the Mekong region.
Keywords: Smart Water Plus, Internet of Things, artificial intelligence, big data, water purification, Korea and Vietnam cooperation.

Development of an Open Data-Based AI Learning Testbed for Medical Information Integration at Ton Duc Thang University and Mekong University

Dao Van Tuyet[1], Lee Hye Kyung[2], Kim Do Kyong[2], Phuong T. Tran[3], Nguyen Dang Khoa[4], Hua Phu Doan[5], Tran Duc Dung[6], Kim Hyung Nam[7], and Ngo Minh Dat[3]
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Abstract. This paper introduces a collaborative research initiative between Ton Duc Thang University (TDTU) and Mekong University (University of Cuu Long) in cooperation with Korean partners to develop an open data–based AI learning testbed for medical information integration. The proposed system employs Node-RED, AI-driven analytics, and standardized medical data formats such as HL7, FHIR, and DICOM to build an experimental environment for research, training, and healthcare innovation. Two complementary platforms—the TDTU AI Cloud Testbed and the Mekong University Clinical Data Testbed—enable real-time medical data simulation, interoperability assessment, and predictive modeling for clinical decision support. The initiative demonstrates how open technologies and collaborative frameworks can promote data sharing, medical education, and AI application in healthcare, laying the groundwork for Vietnam's future smart hospital development.
Keywords: Open data, artificial intelligence, medical informatics, interoperability, clinical decision support.

Developing Smart Energy Management Solutions for Carbon Credit Enterprises in Vietnam

Vo Dinh Tung[1], Phuong T. Tran[2], Hwang Duk Yun[3], Kim Do Kyong[4], Na Hyun Ju[5], Kim Hyung Nam[6], Le Nhat Huy[7], and Dat M. Ngo[7]
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Abstract. This paper proposes a methodological framework to develop a Smart Energy Management System (SEMS) grounded in the Zero Energy Building and Building Energy Management System paradigm. The work is centered on a pilot testbed under development at Ton Duc Thang University that integrates solar photovoltaic generation for building level loads, the SEE AI driven air conditioning system, and high fidelity electrical measurement using Light Star instruments. The testbed continuously collects multi source data for analytics, trains predictive models, and closes the loop through optimal control toward carbon neutral operation. Rather than reporting end state experimental results, the study contributes a replicable process for design, deployment, and iterative learning. The framework specifies subsystem roles, data pipelines, learning objectives, and evaluation metrics that enable measurable energy reduction and verifiable carbon abatement in the built environment of Vietnam. The approach is intended to generalize across public, commercial, and industrial buildings where interoperability, data quality, and carbon verification are critical.
Keywords: SEMS, zero-energy building, building energy management system, testbed, energy reduction, AI control, big data, carbon neutrality.

Session D-3 – Intelligent Networks
Day 1 – 11 December, 2025 Thursday
Time: 16:20 ~ 17:40; Venue: Room A403
Session Chair: Prof. Roman Šenkeřík (Tomas Bata University, Czech Republic)
Co-session Chair: Dr. Le Anh Vu (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	16:20 ~ 16:37	**FF-DTOS: A Fuzzy-Federated Framework for Intelligent Traffic Optimization** Duy Lap Le, and Thinh Vinh Le
2	16:38 ~ 16:55	**A Privacy-Preserving Access Control Framework for Environmental Data using Consortium Blockchain and Zero-Knowledge Proof** Kwangman Ko, Oudone Phengkamlar, Bumsuk Yang, Hanyong Choi
3	16:56 ~ 17:13	**Scalable APB-to-SPI Architecture for Low-Power, High Speed Edge Intelligence** Ngoc-Tri Phan, Van-Khoa Pham
4	17:14 ~ 17:31	**AndroBank: Processing failure as an indicator** Ladislav Dorotík, Milan Oulehla, Roman Šenkeřík, David Malaník and Zuzana Komínková Oplatková
5	17:32 ~ 17:50	**Automatic breast mass detection using image quality enhancement and Mask-RCNN-based deep learning model** Duc Lam Pham, Nam Nguyen

FF-DTOS: A Fuzzy-Federated Framework for Intelligent Traffic Optimization
Duy Lap Le[1], and Thinh Vinh Le[1]
[1]*HCMC University of Technology and Education, Thu Duc, Ho Chi Minh City, Vietnam*

Abstract. Accurate yet privacy-preserving traffic prediction remains challenging in intelligent transportation systems, especially with distributed and heterogeneous sensor data. This paper introduces FF-DTOS (Fuzzy-Federated Dynamic Traffic Optimization System), a hybrid framework integrating Federated Learning and Fuzzy Trust Modeling to ensure robust and interpretable collaboration among edge clients. Each client trains locally and evaluates its update through a Mamdani fuzzy inference system using three linguistic features based on traffic data such as Speed, Occupancy, and Speed change to produce a fuzzy congestion coefficient (Ck) that adaptively weights contributions in global aggregation. Experiments on the METR-LA benchmark (207 sensors) demonstrate that FF-DTOS consistently outperforms the FedAvg base line, achieving a 0.16% increase in Accuracy and a significant 0.74% improvement in Macro-F1 Score. These metrics highlight the model's superior sensitivity in detecting minority "Severe" congestion classes, which are frequently misclassified by traditional averaging methods. Furthermore, unlike state-of-the-art Graph Neural Network (GNN) based Federated Learning approaches which require significant computational and bandwidth resources, FF-DTOS leverages lightweight MLPs to ensure low-latency operation at the network edge. The findings establish FF-DTOS as a robust, interpretable, and resource-efficient solution for privacy-preserving traffic optimization.
Keywords: DTOS, Federated Learning, Fuzzy, Intelligent System, Privacy

A Privacy-Preserving Access Control Framework for Environmental Data using Consortium Blockchain and Zero-Knowledge Proof
Kwangman Ko[1], Oudone Phengkamlar[1], Bumsuk Yang[2], Hanyong Choi[3]
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[3]*Shinhan University, Republic of Korea*

Abstract. The increasing collection and use of bio-healthcare data are severely challenging patient privacy and data trustworthiness. Current centralized systems are vulnerable to manipulation and lack selective confidentiality. To address these limitations, this study proposes a novel data management framework combining Private (or

Consortium) Blockchain and Zero-Knowledge Proof (ZKP) technology. The Private Blockchain ensures confidentiality and access control by restricting data recording and management to authorized participants. Crucially, ZKP enables the verification of data integrity—such as meeting specific research or diagnostic criteria—without revealing the sensitive raw data, thereby maximizing privacy. This combined framework guarantees the immutability and integrity of healthcare data, and is expected to contribute significantly to building a trustworthy digital ecosystem for essential medical applications, including secure clinical research and precision medicine data sharing.
Keywords: Blockchain, Privacy-Preserving, Data Security, Software Security, Zero-Knowledge Proof.

Scalable APB-to-SPI Architecture for Low-Power, High Speed Edge Intelligence
Ngoc-Tri Phan[1], Van-Khoa Pham[1]
[1]*Ho Chi Minh City University of Technology and Education, Vietnam*

Abstract. In modern smart cities, massive numbers of sensors generate large data streams that must be moved rapidly, processed close to the source, and handled with low power at the edge. Many existing APB-to-SPI bridges operate at modest shift-clock speeds and often lack clear documentation of internal operation, limiting their suitability for high-performance, energy-constrained applications. This work introduces a modular, APB4-compatible SPI IP core that employs dual clock FIFOs to ensure robust communication between on-chip IP modules and SPI peripherals in a System-on-Chip context. The architecture is partitioned into functional blocks, each responsible for a specific role and interconnected through standardized interfaces. This modularity simplifies later extensions and feature additions without requiring major architectural redesign. Data transfers are coordinated by FIFO-based buffering, which safely bridges clock domains. As a result, data can be written and read at independent rates without collisions, effectively mitigating clock-domain crossing challenges. By surveying prior designs, we distilled and integrated key strengths of SPI cores into our architecture. The proposed design supports both Master and Slave modes, up to four selectable slave devices, and a maximum data width of 32 bits with configurable LSB-first or MSB-first transmission, along with four shift-clock formats, while enhancing overall throughput. Compared with typical earlier SPI cores that often provide only 8-bit data width and fewer slave options, the presented design offers expanded functionality and flexibility. In addition, it integrates an APB4 interface and achieves a shift-clock frequency of 56.8 MHz, substantially higher than the shift-clock rates commonly reported in prior studies.
Keywords: Advanced Peripheral Bus, Serial Peripheral Interface, System-on Chip, Synchronous FIFO, Edge Intelligence.

AndroBank: Processing failure as an indicator
Ladislav Dorotík[1], Milan Oulehla[1], Roman Šenkeřík[1], David Malaník[1], and Zuzana Komínková Oplatková[1]
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Abstract. Modern static analysis of Android applications relies on tools that decompile and normalise APKs before feature extraction. Robust tools such as Apktool or Androguard are valuable in practice, but their automated fixes can hide malformed inputs and anti-analysis techniques. We examine processing failures in the AndroBank dataset, comprising over 20,000 applications, and derive a taxonomy of six errors and eight warning categories observed during processing. We focus on three chosen error types: AXML manifest parsing failures, apktool.yml parsing errors, and ZIP-level anomalies that cause AAPT2 to reject APK. These categories affect between 0.53 % and 1,49 % of all analysed applications. Although these failures are relatively infrequent, they systematically break or degrade automated analyses, while often still allowing installation and execution on devices. We suggest that processing failures should be treated as complementary features in existing Android malware detection pipelines. In total, an error or warning occurred in 1,202 cases, corresponding to 5.75 % of the dataset when aggregated over all categories.
Keywords: Android, Detection, Failure, Malware, Processing.

Title: Automatic breast mass detection using image quality enhancement and Mask-RCNN-based deep learning model.

Authors: Duc Lam Pham[1], and Hoang Nam Nguyen[2]
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Abstract: Early detection of breast mass cancer is very important for improving survival rate of women worldwide. This works focuses on applying convolution neural network for classifying mammogram images as containing breast mass (positive case) or without breast mass (negative case). In the first stage, mammograms from DDSM dataset are preprocessed and enhanced using image processing techniques. In the second stage, Mask-RCNN model is trained on 3000 mammograms from DDSM dataset. We then test the utilized CNN model on 250 images from DDSM dataset. The result shows that the proposed method can achieve 97.5% accuracy on testing dataset in classifying mammograms as positive or negative. This proved that the CNN artificial intelligence model is really effective in assisting medical doctor in diagnosing of breast cancer.

Keywords: deep learning, Mask-RCNN, breast cancer, convolution neural network

Session A-4 – Power Electronics 1
Day 2 – 12 December, 2025 Friday
Time: 08:50 ~ 09:45; Venue: Room A101
Session Chair: Prof. Wu-Ching Chou (National Yang Ming Chiao Tung University, Taiwan)
Co-session Chair: Dr. Tran Dinh Cuong (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	08:50 ~ 09:07	**Advanced Scalar Control Based on Estimated Rotor Flux Angle in Induction Motor Drive** Cuong Dinh Tran, Tai Thanh Phan, Bach Hoang Dinh, Sang Dang Ho, Trung Chi Truong, Khoa Dang Tran Phan, Huy Duc Bui
2	09:08 ~ 09:25	**Synergistic Adaptive Synchronization Control for Dual-Motor System Integrating Sigmoid-Regulated Cross-Coupling and Linear Feedback Controller** Nhut Thang Le, Cong Toai Truong, Trung Dat Phan, Huy Hung Nguyen, Tan Tien Nguyen and Van Tu Duong
3	09:26 ~ 09:45	**High Step-Up Single-Switch DC–DC Converter with Capacitor–Inductor Cell and P&O-Based MPPT Control for Photovoltaic Systems** Thanh-Lam Le, Tran Quoc Dat, Thanh Lam Nguyen, Phuc Khang Nguyen, Thanh Nhan Nguyen, Hung Nguyen, Van Duong Vang, Khanh Doan Pham, MinhHoc Duong Le, and Huynh Van Van
09:45 ~ 09:55		Coffee Break

Advanced Scalar Control Based on Estimated Rotor Flux Angle in Induction Motor Drive

Cuong Dinh Tran[1], Tai Thanh Phan[1], Bach Hoang Dinh[1], Sang Dang Ho[1], Trung Chi Truong[2], Khoa Dang Tran Phan[3], Huy Duc Bui[3]
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Abstract. The scalar control method, known as the constant voltage-to-frequency (V/f) strategy, is widely used in speed control for industrial drives that do not require high precision. However, due to its inherent characteristics, scalar control has limitations in dynamic response, especially in matching the reference speed. A noticeable difference between the reference and rotor speed often occurs when the motor operates under changing load conditions. This research presents an advanced scalar control method that incorporates rotor flux angle estimation within a closed-loop structure. The proposed scheme enhances both speed matching and overall system stability. A mathematical model of the method has been developed, and three case studies have been simulated in MATLAB/Simulink to evaluate its performance. Results demonstrate that the proposed closed-loop scalar control effectively addresses the limitations of the typical open-loop method, ensuring that rotor speed more closely follows the reference with a shorter settling time.
Keywords: Scalar Control, Rotor Flux Angle Estimation, Induction Motor.

Synergistic Adaptive Synchronization Control for Dual-Motor System Integrating Sigmoid-Regulated Cross-Coupling and Linear Feedback Controller

Nhut Thang Le[1,2], Cong Toai Truong[1,2], Trung Dat Phan[1,2], Huy Hung Nguyen[3], Tan Tien Nguyen[1,2], and Van Tu Duong[1,2]
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Abstract. This paper presents a hybrid synchronization control framework com-bining cross-coupling and feedback linearization for a dual-motor system. Unlike fixed-gain approaches, it employs a sigmoid-based nonlinear function of the cross-error to adapt coupling gains smoothly and within bounds. The controller is derived from a second-order motor model, and stability is verified via Lya punov analysis. Simulations under voltage limits ±5 V, white noise 0.001 rad/s, and oscillations at 4 s and 8 s demonstrate fast and stable synchronization. The proposed method achieves a synchronous settling time of 0.2 s while maintaining a reference settling time of 0.4 s, consistent with design parameters $\xi = 0.5$, $\omega = 20$ rad/s). Cross-error components below 5 Hz are eliminated, with deviations confined to ±0.004 rad/s, and coupling gains remain bounded, increasing by about 8 and 11 for the two motors, respectively.
Keywords: Synchronous Control, Cross-Coupling Strategy, Sigmoid Function, Feedback Linearization Control.

High Step-Up Single-Switch DC–DC Converter with Capacitor–Inductor Cell and P&O-Based MPPT Control for Photovoltaic Systems

Thanh-Lam Le[1], Tran Quoc Dat[1], Thanh Lam Nguyen[1], Phuc Khang Nguyen[1], Thanh Nhan Nguyen[1], Hung Nguyen[1], Van Duong Vang[1], Khanh Doan Pham[1], MinhHoc Duong Le[2], and Huynh Van Van[3]
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Abstract. The fluctuating output voltage of photovoltaic (PV) arrays under varying so-lar irradiance and temperature requires an efficient high-gain dc–dc conver-sion stage to ensure maximum power extraction. Conventional boost con-verters, though simple in structure, suffer from severe efficiency loss and high component stress when operated at extreme duty ratios. To overcome these drawbacks, this paper proposes a high step-up single-switch dc–dc converter based on a capacitor–inductor (C–L) cell integrated with a perturb-and-observe (P&O) maximum power point tracking (MPPT) algorithm. The proposed configuration employs a dual energy-transfer mechanism that combines parallel charging and series discharging to achieve substantial volt-age gain at moderate duty ratios while maintaining continuous input current and low voltage stress on switching devices. A detailed steady-state analysis and operating principle are presented, followed by the implementation of a direct-duty P&O control for real-time power optimization. Simulation studies conducted in MATLAB/Simulink under dynamic irradiance profiles verify that the proposed converter achieves higher voltage gain, faster MPPT con-vergence, and improved energy conversion efficiency compared with the conventional boost topology. These results demonstrate the suitability of the proposed C–L cell–based converter for compact, high-efficiency PV energy-conversion systems.
Keywords: Photovoltaic (PV) Energy Conversion, Renewable Energy Systems, Maximum Power Point Tracking (MPPT), Perturb and Observe (P&O) MPPT

Session A-5 – Power Electronics 2
Day 2 – 12 December, 2025 Friday
Time: 10:40 ~ 12:10; Venue: Room A101
Session Chair: Assoc. Prof. Tan Luong Van (Ho Chi Minh City University of Industry and Trade, Vietnam)
Co-session Chair: Assoc. Prof. Van Van Huynh (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	10:40 ~ 10:57	**Novel Over-Constant Boost Control Technique for Z-Source Inverter** Tan Luong Van, Bang Nguyen and Duc-Dung Le
2	10:58 ~ 11:15	**Design and Implementation of a Variable Frequency Drive for Three-Phase Induction Motors** Cuong Dinh Tran, Quang Thanh Nguyen, Tri-Vien Vu
3	11:16 ~ 11:33	**Application of Three-Term Controller in Experiment of Mobile Robot Tracking Trajectory** Duy-Khanh Pham and Anh-Tuan Le
4	11:34 ~ 11:51	**Designing the Sliding Mode Controller for Permanent Magnet Synchronous Motors with Field-Oriented Control** Thinh Cong Tran, Hau Huu Vo, Pavel Brandstetter, Nguyen Minh Truc, Nguyen Thi Hoa, Nguyen Huu Hieu, and Ho Dang Sang
5	11:52 ~ 12:09	**Efficient Load Frequency Control for an Isolated Power System with Wind Power Source using Sliding Mode** Anh-Tuan Tran, Van Van Huynh, Dao Trong Tran
12:10 ~ 13:40		Lunch

Novel Over-Constant Boost Control Technique for Z-Source Inverter
Tan Luong Van[1], Bang Nguyen[1], and Duc-Dung Le[1]
[1]*Ho Chi Minh City University of Industry and Trade, Ho Chi Minh City, Vietnam*

Abstract. This paper presents a novel over-constant boost control (OCBC) technique for Z-source inverters (ZSI). Existing studies have introduced several well-known control methods, including the simple boost, maximum boost, and maximum constant boost techniques. The proposed OCBC strategy represents the final element completing the family of possible boost control schemes for Z-source inverters, extending the achievable voltage range beyond the constant-boost boundary. Unlike existing boost control methods that rely on complex mathematical derivations, trigonometric functions, or modulation constraints to determine shoot-through intervals, the proposed OCBC employs a straightforward analytical relationship between voltage reference, and shoot-through duty ratio. This simplicity enables real-time computation with minimal control effort, making the technique highly practical for digital implementation. Furthermore, the paper provides an in-depth analysis of the voltage gain characteristics with respect to the modulation index and compares them with other boost strategies. Simulation results are provided for validation.
Keywords: pulse width modulation (PWM), voltage boost, Z-source inverter.

Design and Implementation of a Variable Frequency Drive for Three-Phase Induction Motors
Cuong Dinh Tran[1], Quang Thanh Nguyen[2], Tri-Vien Vu[2]
[1]*Power System Optimization Research Group, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*
[2]*Modeling Evolutionary Algorithms Simulation and Artificial Intelligence, Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. This paper presents the design and implementation of a laboratory scale variable frequency drive (VFD) for a three-phase induction motor, developed as an educational platform for engineering students. The system provides a practical framework for demonstrating motor control principles, enabling the study of industrial motor characteristics and control algorithm application. The VFD prototype features a six-IGBT power module managed

by a central microcontroller, implementing scalar V/f control through sinusoidal pulse width modulation (SPWM). The entire development process – including hardware design, control software creation, and experimental validation – was completed. The proposed VFD, including the combination of hardware design and the control algorithm, has successfully met the specified control requirements; the motor runs steadily around the target value with proper deviation.
Keywords: VFD, induction motor, IGBT, inverter, microcontroller, V/f, SPWM

Application of Three-Term Controller in Experiment of Mobile Robot Tracking Trajectory
Duy-Khanh Pham[1] and Anh-Tuan Le[1]
[1]*Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. Controlling a differential wheeled robot to track trajectories using pro portional, integral, and derivative (PID) control structure or three-term controller aims to drive the robot for tracking various types of trajectories by controlling two separately driven wheels placed on either side of the robot body. The control system is designed with four main parts. In which, the first part is to determine the desired trajectory for the moving robot and discretize the coordinates of that trajectory according to the x and y positions in a 2D Cartesian coordinate system. The inverse kinematic part relies on direction angle and the desired x and y coordinates of robot to give the reference velocity of the two wheels. The linear velocity of the two wheels are calculated based on forward kinematics to find the current position of the model. And finally, the actual velocities of two driven wheels approach their reference values by properly adjusting the controller parameters. The comparison between experimental results and simulation results using Matlab software based on the mathematical model of the robot shows the accuracy of the implemented actual robot model.
Keywords: Differential wheeled robot, Forward kinematics, Inverse kinematic, PID controller, Tracking trajectory.

Designing the Sliding Mode Controller for Permanent Magnet Synchronous Motors with Field-Oriented Control
Thinh Cong Tran[1], Hau Huu Vo[1], Pavel Brandstetter[2], Nguyen Minh Truc[3], Nguyen Thi Hoa[3], Nguyen Huu Hieu[3], and Ho Dang Sang[3]
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[2]*Faculty of Electrical Engineering and Computer Science, VSB–Technical University of Ostrava, Czech Republic*
[3]*Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. The paper presents a speed sliding mode controller specifically designed for Permanent Magnet Synchronous Motors (PMSM). It also discusses the traditional PID speed controller used for PMSM. The Sliding Mode Control (SMC) model offers several advantages and is suitable for nonlinear control systems, reducing reliance on system parameters and external disturbances. These speed control algorithms are im plemented on the PMSM motor model using the Field-Oriented Control (FOC) method, which is known for its remarkable features, including effective torque control at low and stationary speeds, high efficiency, and rapid dynamic response. Simulation results, conducted in MATLAB Simulink under various operating conditions, such as constant speed and load torque, consistent load steps, and speed variations according to a sinusoidal function, demonstrate the significant benefits of the SMC in speed control when compared to the traditional PID method.
Keywords: Permanent Magnet Synchronous Motors, SMC, Field-Oriented Con trol, PID.

Efficient Load Frequency Control for an Isolated Power System with Wind Power Source using Sliding Mode
Anh-Tuan Tran[1], Van Van Huynh[1], Dao Trong Tran[1]
[1]*Modeling Evolutionary Algorithms Simulation and Artificial Intelligence, Faculty of Electri-cal and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Abstract. This paper presents the design of an integral sliding mode controller (SMC) for an isolated power system integrated with a wind power source operating under random load conditions. The proposed system comprises a non-reheat thermal power plant and a wind energy source. The proposed SMC is developed based on an integral sliding surface, ensuring that frequency deviations remain within acceptable limits. Under random load disturbances, the proposed control strategy effectively maintains system stability and achieves the desired

performance objectives. Simulation results demonstrate that the integral SMC provides small steady-state errors and fast settling times, thereby validating the superior performance of the proposed controller.
Keywords: Load frequency control; power systems; sliding mode control.

Session B-4 – Computer Science
Day 2 – 12 December, 2025 Friday
Time: 08:50 ~ 09:45; Venue: Room B010
Session Chair: Assoc. Prof. Truong Ngoc Son (Ho Chi Minh City University of Technology and Education, Vietnam)
Co-session Chair: Dr. Lam-Thanh Tu (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	08:50 ~ 09:07	**Quantum Kernel SVM for API-Call–Based Malware Classification** Aktham Youssef, Ivan Zelinka
2	09:08 ~ 09:25	**Improving the Robustness of Memristive Neural Networks by a Device Variation-Aware Training Scheme** Son Ngoc Truong, Van Thinh Lai, and Thi Kim Hang Pham
3	09:26 ~ 09:45	**Design of an Analog Spiking Neural Network Circuit Using the Izhikevich Model for Handwritten Character Recognition on 180nm CMOS Process** Mai-Minh-Kha Nguyen, Thi-Tra-Chi Nguyen, Duc-Minh-Duy Phung, Duc-Hung Le
09:45 ~ 09:55		

Quantum Kernel SVM for API-Call–Based Malware Classification
Aktham Youssef[1], Ivan Zelinka[1,2]
[1]*Department of Computer Science, Faculty of Electrical Engineering and Computer Science, VSB–Technical University of Ostrava, 708 00 Ostrava, Czech Republic* ˇ
[2]*Quantum Computing Lab, IT4Innovations National Supercomputing Center, VSB–Technical University of Ostrava, 708 00 Ostrava, Czech Republic*

Abstract. Malware classification from API-call sequences was evaluated using a quantum-kernel support vector machine. API sequences
were converted to TF–IDF features, standardized, reduced in dimension, scaled to a bounded range, and embedded with a ZZFeatureMap; a fidelity-based quantum kernel provided the similarities used by the classifier. A cumulative learning-curve protocol increased training data in stages while keeping test sets disjoint. Accuracy improved with more data and then leveled off, while runtime grew quadratically with training size due to kernel computation. The findings suggest that quantum kernels can be competitive on compact API representations but face scalability limits; approximate-kernel strategies are outlined as a path forward.
Keywords: Quantum machine learning, quantum kernel, malware detection, API calls, TF–IDF, dimensionality reduction.

Improving the Robustness of Memristive Neural Networks by a Device Variation-Aware Training Scheme
Son Ngoc Truong[1], Van Thinh Lai[1], and Thi Kim Hang Pham[1]
[1]*HCMC University of Technology and Education, Viet Nam*

Abstract. Deep Neural Networks (DNNs) have demonstrated remarkable performance across a wide range of applications. However, most deep models rely heavily on computationally intensive operations, such as multiplication and ac cumulation. These models are efficiently deployed on high-performance computing systems, but their implementation on resource-constrained platforms remains challenging. Hardware implementation of DNN offers an alternative approach to emulate the massively parallel processing capability of the human brain. Memristor-based crossbar arrays with three-dimensional structures represent a promising candidate for implementing high-density DNN models. Such architectures leverage computing-in-memory and intrinsic parallelism to reduce both power consumption and computational latency, making them highly suitable for edge AI devices. Despite these advantages, hardware-based implementations face several challenges, such as device-level variations. To address this issue, we employ a weight variation-aware training scheme, referred to as Random Weight Perturbation, which enables the model to adapt to device variability. The proposed method is evaluated on

the MNIST dataset using a neural network architecture consisting of 784 input neurons, 512 hidden neurons, and 10 output neurons. The circuit evaluations confirm that the memristor-crossbar circuit trained with stochastic gradient descent and random can improve the recognition accuracy by 18% as the device variation is 12%. These results confirm that applying the Random Weight Perturbation method during training enables the memristor crossbar-based neural network to tolerate device-to-device variation more effectively, thereby enhancing its robustness and reliability.

Keywords: Deep Neural Network, Memristive neural network, Weight variation aware.

Design of an Analog Spiking Neural Network Circuit Using the Izhikevich Model for Handwritten Character Recognition on 180nm CMOS Process

Mai-Minh-Kha Nguyen[1,2], Thi-Tra-Chi Nguyen[1,2], Duc-Minh-Duy Phung[1,2], Duc-Hung Le[1,2]
[1]*Faculty Electronics and Telecommunications, University of Science, Ho Chi Minh City, Vietnam*
[2]*Vietnam National University, Ho Chi Minh City, Vietnam*

Abstract. This paper presents a Spiking Neural Network (SNN) circuit based on the Izhikevich neuron model, implemented on an 180nm CMOS process for handwritten character recognition of both uppercase and low ercase letters. The network is trained and evaluated using the EMNIST Letters dataset, which contains 26 alphabetic characters with over 40,000 samples. Each image is converted into a time-dependent spike train on the Google Colab platform before being fed into the network. The learning process employs an unsupervised Spike-Timing-Dependent Plastic ity (STDP) mechanism and Winner-Take-All (WTA) to update synaptic weights in a biologically realistic manner. The proposed SNN introduces a connection-efficient synapse structure compared with a fully connected architecture. The CMOS-based implementation improves both performance and area efficiency, while simulation results show a recognition time of 500ns per character and an energy efficiency of 444.16fJ/spike. These results demonstrate the potential of the proposed SNN for low power, high-speed neuromorphic computing applications.

Keywords: HandwrittenCharacter Recognition, Izhikevich, SNNs, STDP, Spiking Neural Networks.

Session B-5 – Artificial Intelligence
Day 2 – 12 December, 2025 Friday
Time: 10:40 ~ 12:10; Venue: Room B010
Session Chair: Assoc. Prof. Duc Ngoc Minh Dang (FPT University, Vietnam)
Co-session Chair: Dr. Nguyen Hoang Nam (Ton Duc Thang University, Vietnam)

1	10:40 ~ 10:57	**Efficient Hybrid Quantum-Classical Convolutional Neural Network with Feature Propagation Layer for Multi-Class Image Classification** Quang Nhan Hoang, Thanh Trung Pham, and Duc Ngoc Minh Dang
2	10:58 ~ 11:15	**Real-Time Stroke Monitoring IoT System Using Federated Learning** Prisilla N., N. Gomathi
3	11:16 ~ 11:33	**Hybrid Classroom Attendance via Haarcascade–MTCNN Detection and FaceNet Recognition** Quoc-Tuan Mai, Van-Khoa Pham
4	11:34 ~ 11:51	**ECG-Based Optimal Deep Learning System for Multi-Label Classification of Cardiac Diseases** Hung Van Tran, Thua Trong Huynh and Thang Viet Tran
5	11:51 ~ 12:10	**Performance Evaluation of Feature-Based Approaches to Malicious URL Detection** Thanh Cong Pham, Tran Cong Hung, Thanh Duc Vu, Hong Manh Le Dinh
12:10 ~ 13:40		Lunch

Efficient Hybrid Quantum-Classical Convolutional Neural Network with Feature Propagation Layer for Multi-Class Image Classification

Quang Nhan Hoang[1], Thanh Trung Pham[2], and Duc Ngoc Minh Dang[1]
[1]*AiTA Lab, Department of Computing Fundamentals, FPT University, Ho Chi Minh City, Vietnam*
[2]*Department of Artificial Intelligence, Kyung Hee University, Republic of Korea*

Abstract. Deep learning models are effective for image classification, achieving high accuracy, and have numerous applications across various fields. However, they require a significant amount of computational cost, and the number of training parameters increases substantially. In this study, we propose a hybrid quantum-classical model based on a Quantum Convolutional Neural Network (QCNN) for feature extraction, followed by a Dense Layer for classification. The model is trained on two benchmark datasets: MNIST (10 classes) and EMNIST Balanced (47 classes), and achieves competitive performance on test sets comparable to that of traditional CNN models with fewer parameters. This has opened up new approaches for future image classification tasks, potentially offering competitive accuracy compared to classical deep learning systems, with less computational resources and improving speed on quantum hardware.
Keywords: Quantum machine learning, hybrid quantum-classical model, quantum neural network, quantum convolutional neural network, multi class image classification.

Real-Time Stroke Monitoring IoT System Using Federated Learning

Prisilla. N[1], N. Gomathi[1]
[1]*Department of Computer Science and Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology Avadi, Chennai, Tamilnadu, India*

Abstract. Stroke, still a leading cause of death and long-term disability globally, is a particularly useful case in highlighting the limitations of traditional medical approaches to brain imaging-based diagnosis in ambiguity and revertibility, at least in the pre-hospital or remotely available setting. To address these limitations, a novel IoT integrated federated deep learning framework for real time stroke monitoring and detection is proposed in this study. The system detects a stroke-related facial palsy to high diagnostic accuracy with minimal and unobtrusive human intervention through automatic recognition using YOLOv8. Federated Learning (FL), a method that ensures that data privacy is preserved while performance and generalization remain unaffected, is adopted to ensure that the models are trained in a decentralized manner across the healthcare nodes that are connected to the Internet of

Things (IoT). The framework, which is realized on Nvidia GPU-accelerated platforms, offers the fast computation and real-time responsiveness which are essential in emergency situations. Aided stroke detection, privacy-preserving distributed learning, continuous Internet of Things (IoT) monitoring and scalable low latency deployment represent selected major contributions. The proposed system will be a next-generation privacy-integrated diagnostic system that has higher accuracy and enhances data security and faster medical responses through combining FL, IoT sensing and AI-based analytics. Armed with intelligent tools, VETNHA creates effective real-time decision support for doctors to reach patients at the optimal time, significantly improving patient outcomes and reducing the prevalence of neurological disorders across the globe.
Keywords: Stroke detection, Federated Learning (FL), Real-time monitoring, Privacy preservation, Medical imaging, Neurological care.

Hybrid Classroom Attendance via Haarcascade–MTCNN Detection and FaceNet Recognition
Mai Quoc Tuan[1], Pham Van Khoa[1]
[1]*Ho Chi Minh City University of Technology and Education, Vietnam*

Abstract. Automatic attendance tracking can reduce administrative workload and dis-courage proxy attendance. This study presents a hybrid face detection–recognition system tailored to classroom environments. A lightweight Haar cascade detector is used for clear, small scenes, while a Multi-task Cascaded Convolutional Network serves as a fallback for crowded or ambiguous frames. Identification is performed using FaceNet embeddings with ℓ2-distance matching. The implementation is a CPU-only Django application with HTML templates and runs on commodity hardware. In tests on class-room images, the system achieved detection latencies of 0.11–0.16 71sec/image for single individuals. For small groups, the hybrid pipeline pre-served face counts while reducing latency by ≈30% relative to MTCNN alone (0.36–0.40 vs. 0.49–0.71sec/image). In a large-group scenario, MTCNN de-tected 81 of 82 faces, whereas the Haar cascade identified 73 with one false positive. The hybrid approach eliminated the false positive, yielding 72 cor-rect detections at a latency of approximately 4.5–5.0 sec/image. For recogni-tion, FaceNet achieved substantially lower inference time than LBPH across cases and succeeded on a challenging crowd image where LBPH failed. These results indicate that a simple detector switch can balance speed and robustness for attendance-oriented deployments on modest hardware.
Keywords: Face recognition, FaceNet, MTCNN, attendance management, Haar cascade.

ECG-Based Optimal Deep Learning System for Multi-Label Classification of Cardiac Diseases
Hung Van Tran[1], Thua Trong Huynh[2], and Thang Viet Tran[1]
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[2]*Faculty of Information Technology, Posts and Telecommunications Institute of Technology, Ho Chi Minh City, Vietnam*

Abstract. This paper presents a deep learning pipeline for the multi-label classification of cardiac pathologies using the PTB-XL dataset, a large-scale public repository available on the PhysioNet platform. The study focuses on the five primary diagnostic superclasses: Normal (NORM), Myocardial Infarction (MI), ST/T Change (STTC), Conduction Disturbance (CD), and Hypertrophy (HYP). An ECGResNet2D, a 2D Residual Convolutional Neural Network, was trained for 30 epochs using the Adam optimizer and BCEWithLogitsLoss. A core challenge addressed is the significant class imbalance inherent in the dataset, with a notable disparity between the majority class (NORM) and minority classes (e.g., HYP). Quantitative results demonstrate the model's high performance on the NORM class (89.82% Recall) but reveal compromised efficacy on minority classes, such as MI (41.09% Recall) and HYP (10.71% Recall). Furthermore, we introduce a complete two-phase system architecture, culminating in a functional web platform for qualitative testing and real-world application demonstration. This work establishes a baseline performance and concludes that future development must focus on optimization strategies, such as class weighting or resampling, to mitigate the effects of data imbalance and improve diagnostic accuracy for underrepresented pathologies. Unlike previous studies that predominantly focus solely on offline model improvements, this paper proposes a holistic approach. We enhance model robustness on the complex PTB-XL dataset using data augmentation strategies (random noise injection and temporal shifting) integrated with a custom 2D-ResNet architecture, achieving a validation accuracy of 0.92, surpassing standard baseline models. Furthermore, a significant contribution of this work is the development of a Web-based ECG analysis system, demonstrating the practical deployment capability of the proposed model for real-time clinical decision support.

Keywords: Convolutional Neural Network (CNN), Data Imbalance, Deep Learning, Electrocardiogram (ECG), Multi-label Classification, PTB-XL.

Performance Evaluation of Feature-Based Approaches to Malicious URL Detection

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Abstract. Phishing and link-borne malware attacks continue to grow, creating demand for URL-based threat detection methods that balance accuracy with scalability. This paper presents a hybrid detection framework that integrates heuristic signals with machine-learning techniques and benchmarks two classifiers: Support Vector Machine (SVM) and Random Forest (RF). The proposed feature architecture spans lexical, host-based, and content-based attributes, enabling the model to capture both structural and behavioral indicators of malicious activity. Using a dataset of approximately 470,000 URLs (≈70,000 malicious and ≈400,000 benign), the experiments demonstrate that Random Forest consistently outperforms SVM across evaluation metrics. Accuracy, Precision, Recall, F1 score, PR-AUC, and confusion-matrix analysis further confirm the robustness and practical viability of the approach.
Keywords: malicious URL, machine learning, Random Forest, SVM, phishing, URL features.

Session C-4 – Sustainable Energy 1
Day 2 – 12 December, 2025 Friday
Time: 08:50 ~ 09:45; Venue: Room C010
Session Chair: Assoc. Ngoc Dieu Vo (Ho Chi Minh City University of Technology, Vietnam)
Co-session Chair: Dr. Nguyen Cong Trang (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	08:50 ~ 09:07	**Techno-Economic Optimization of a Grid-Connected Solar Microgrid with Battery Storage: A Case Study at Long Phu C Primary School** Huu Tinh Tran, Ngoc Dieu Vo, Si Tai Nguyen, Nhut Tien Nguyen
2	09:08 ~ 09:25	**A new SOS variant for Directional Overcurrent Relay Coordination to Enhance Conductor Thermal-Damage Margin in DG-Integrated Distribution Networks** Tuan Khanh Dang, Nhat Huy Huynh, Mai Khanh Dung Hoang, Le Duc Nguyen, Khoa Hoang Truong, Dieu Ngoc Vo
3	09:26 ~ 09:45	**Design and Analysis of Speed Control for Permanent Magnet Synchronous Motor (PMSM) Drives** Cong-Trang Nguyen, Le Hung Thinh, Nguyen Le Minh Hieu
09:45 ~ 09:55		

Techno-Economic Optimization of a Grid-Connected Solar Microgrid with Battery Storage: A Case Study at Long Phu C Primary School

Huu Tinh Tran[1], Ngoc Dieu Vo[2], Si Tai Nguyen[3], Nhut Tien Nguyen[3]
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[2]*Faculty of Electrical & Electronics Engineering, Ho Chi Minh City University of Technology (HCMUT), VNU-HCM, HCMC, Vietnam*
[3]*Faculty of Electrical Engineering, Can Tho University, CTC, Vietnam*

Abstract. This paper presents the results of a study on optimizing solar energy utilization scenarios for a microgrid at an educational facility using HOMER Pro simulation software. The microgrid model was developed based on a grid-connected solar power system configuration with integrated energy storage, and it was applied in practice at Long Phu C Primary School in Can Tho. The optimal scenario includes an 8.5 kW solar PV system, a 57.3 kWh storage battery, and a 10 kW inverter. Simulation results show that this configuration is highly cost-effective, significantly reduces operating costs, improves energy self-sufficiency, maximizes the efficiency of the storage system, and provides clear environmental benefits by lowering CO_2 emissions by approximately 8,355 kg per year. Based on the analysis, the system's payback period is 11 years, and it begins generating profit from the 12th year onward. Therefore, this study demonstrates the potential for applying renewable energy in small-scale public microgrid systems, contributing to sustainable development and greenhouse gas reduction in line with global and national trends.
Keywords: Solar power, microgrid, Homer Pro software, green energy, greenhouse gas emissions.

A new SOS variant for Directional Overcurrent Relay Coordination to Enhance Conductor Thermal-Damage Margin in DG-Integrated Distribution Networks

Tuan Khanh Dang[1,2], Nhat Huy Huynh[1,2], Mai Khanh Dung Hoang[1,2], Le Duc Nguyen[1,2], Khoa Hoang Truong[1,2], Dieu Ngoc Vo[1,2]
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Abstract. We propose COCSOS, a new Symbiotic Organisms Search variant, together with a hybrid inverse-time strategy for directional overcurrent relay coordination in DG-integrated distribution networks. The formulation minimizes a composite objective that balances the sum of primary-relay operating times and the conductors' thermal-damage margin. Time-dial settings and pickup current are optimized simultaneously, and the hybrid

strategy selects among the IEC Normal Inverse, Very Inverse, and Extremely Inverse curves to enlarge the feasible region and accelerate clearing. On a 20 kV, 16-bus network with 25 relays and 26 primary–backup pairs, the objective decreased from 28.004 under the Normal Inverse curve with a coordination time interval of 0.3 s to 9.1935 with the hybrid strategy at coordination time interval of 0.2 s, a reduction of 67.17%. Allowing pickup current variation further reduced it to 8.2022, an additional 10.78% and 70.71% overall. All relays operated in less than 1 s while maintaining the required selectivity interval, and thermal margins were positive for all pairs with expansions up to 3.28 s. Compared with CMDE, GA, PSO, SOS and RAO, COCSOS achieved the best objective with a median gain of 7.29%, indicating improved protection speed and thermal security without compromising selectivity in DG-integrated distribution networks.
Keywords: Chaotic local search, Comprehensive opposition-based learning, Directional overcurrent relay coordination, Symbiotic Organisms Search, Thermal-damage margin.

Design and Analysis of Speed Control for Permanent Magnet Synchronous Motor (PMSM) Drives

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Abstract. This paper presents the design and analysis of the sliding mode controller (SMC) aimed at enhancing the speed control performance of a permanent magnet synchronous motor (PMSM). Although PMSMs are widely utilized for their superior characteristics, achieving precise control is challenging due to the motor's highly nonlinear, multi-variable model and its sensitivity to disturbances and parameter variations. This study constructs an improved SMC, beginning with the system modeling in the d-q rotating reference frame. The control law is designed based on a linear sliding surface and an exponential reaching law, which ensures fast and stable convergence of the error trajectory. To evaluate its effectiveness, the proposed SMC is compared with a conventional PID controller via simulations in MATLAB/Simulink. The results demonstrate that the SMC exhibits a faster dynamic response, negligible overshoot, and superior load disturbance rejection capability compared to the conventional PID controller. These findings confirm that SMC is an effective and robust control strategy suitable for high-performance PMSM drive applications.
Keywords: Permanent Magnet Synchronous Motor, Sliding Mode Control, Proportional-Integral-Derivative (PID) controller, Speed control, Lyapunov stability.

Session C-5 – Sustainable Energy 2
Day 2 – 12 December, 2025 Friday
Time: 09:00 ~ 10:30; Venue: Room C010
Session Chair: Dr. Van Van Huynh (Ton Duc Thang University, Vietnam)
Co-session Chair: Dr. Nguyen Cong Trang (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	10:40 ~ 10:57	**Fault-Tolerant Control Using Backstepping Sliding Mode Control via Radial Basis Function Neuron Networks for UAVs Formation Against External Disturbances** Thien-Quang Nguyen and Vi-Do Tran
2	10:58 ~ 11:15	**Adaptive Fuzzy Proportional Derivative Backstepping Hierarchical Sliding Mode Control for Trajectory Tracking of a Quadcopter UAV** Xuan-Minh Dinh, Tuan-Anh Than Ngoc, Ngoc-Thanh Ta, Quang-Quan Do, Van-Duy Pham, Minh-Tri Nguyen Sy
3	11:16 ~ 11:33	**Improved Fuzzy-PID Controller for the Pitch Angle Control of Variable Speed Wind Turbine Systems** Cong-Trang Nguyen, Van-Trong Ngo, Hai-Son Dao, and Minh-Phuc Le
4	11:34 ~ 11:51	**Numerical Simulation of Magnetic Vector Potentials in Multiconductor Systems Using the Kernel RBF-FE Method** Viet-Anh Hoang, Minh-Thai T. Pham, and Phan-Tu Vu
12:10 ~ 13:40		Lunch

Fault-Tolerant Control Using Backstepping Sliding Mode Control via Radial Basis Function Neuron Networks for UAVs Formation Against External Disturbances

Thien-Quang Nguyen[1] and Vi-Do Tran[1]
[1]Ho Chi Minh City University of Technology and Education, 01 Vo Van Ngan St, Linh Chieu Ward, Thu Duc City, Ho Chi Minh City, Vietnam

Abstract. This paper proposes an active fault-tolerant controller for a multi-UAV formation operating under a virtual leader-follower framework to address challenges like external disturbances and model uncertainties. The proposed control system integrates a Backstepping Sliding Mode Controller (BSMC) to ensure robust trajectory tracking with a Radial Basis Function Neural Network (RBFNN) designed to actively estimate and compensate for unknown disturbances online. Finally, the controller's effectiveness and superior performance are validated through MATLAB/Simulink simulations of a four-UAV formation, demonstrating its significant advantages.
Keywords: UAV, Formation Model, Backstepping, Sliding Mode Control, Fault-Tolerant Control, Radial Basis Function Neuron Networks

Adaptive Fuzzy Proportional Derivative Backstepping Hierarchical Sliding Mode Control for Trajectory Tracking of a Quadcopter UAV

Xuan-Minh Dinh[1], Tuan-Anh Than Ngoc[1], Ngoc-Thanh Ta[1], Quang-Quan Do[1], Van-Duy Pham[1], Minh-Tri Nguyen Sy[1]
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Abstract. This paper proposes a novel adaptive control strategy, termed Fuzzy-PD-BSP-HSMC, to address the trajectory tracking problem of Quadcopters. The proposed method integrates a Sugeno Fuzzy Logic enhanced Proportional Deriva-tive (PD) controller, a Backstepping (BSP) controller, and a Hierarchical Slid-ing Mode Control (HSMC) scheme for improved tracking performance. Specifically, the Sugeno Fuzzy Logic Controller adaptively tunes the proportional and derivative gains of the PD controller based on the tracking error and its derivative to compute the reference attitude angles. The Backstepping controller then generates control inputs for the roll, pitch, and yaw angles, while the HSMC layer governs the overall position control of the Quadcopter. The proposed Fuzzy-PD-BSP-HSMC control framework is implemented and evaluated in the MATLAB&Simulink environment and compared with the conventional PD-SMC-HSMC scheme under a spiral trajectory scenario. The

simulation results demonstrate that the Fuzzy-PD-BSP-HSMC method achieves superior trajectory tracking performance and higher control accuracy compared to the baseline approaches.
Keywords: Quadcopter UAV, Backstepping, Fuzzy Proportional Derivative, Hierarchical Sliding Mode Control, Trajectory Tracking Control

Improved Fuzzy-PID Controller for the Pitch Angle Control of Variable Speed Wind Turbine Systems
Cong-Trang Nguyen[1], Van-Trong Ngo[2], Hai-Son Dao[2], and Minh-Phuc Le[2]
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Abstract. Regulating the pitch angle in Variable Speed Wind Turbine Systems (VSWTs) is critical for stabilizing power output and mitigating mechanical stress under turbulent wind conditions. The conventional Proportional–Integral–Derivative (PID) controller typically faces limitations when dealing with the inherent nonlinear characteristics and uncertainties present in wind turbine dynamics, PID controllers often become ineffective in systems exhibiting strong nonlinearity and can suffer from difficulties such as deprived anti-interference and large overshoot. This study designs and analyzes the Fuzzy-PID controller aimed at improving the performance of wind turbine pitch angle control. The fuzzy logic component provides self-tuning capability and enhances the controller's robustness, while the PID structure ensures stability and fast response. Simulation tests were conducted to compare the proposed Fuzzy-PID controller with the conventional Fuzzy Logic Controller (FLC) based on performance criteria such as overshoot, settling time, and anti-interference capability. The proposed controllers were validated through numerical examples using MATLAB/Simulink software. Specifically, the FPID controller reduces the rotor speed settling time from 0.25 s (with FLC) to 0.22s, decreases the overshoot from 6.5 rad/s to 2.0 rad/s, and achieves a more stable and higher generated power output. This design effectively enhances the global system efficiency and robustness.
Keywords: Fuzzy Logic Controller, Permanent-Magnet Synchronous Generator, PID Controller, Pitch Angle Control, Variable Speed Wind Turbine Systems.

Numerical Simulation of Magnetic Vector Potentials in Multiconductor Systems Using the Kernel RBF-FE Method
Viet-Anh Hoang[1], Minh-Thai T. Pham[1], Phan-Tu Vu[1]
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Abstract. This paper presents an application of a novel numerical method that combines kernel radial basis function (RBF) and traditional finite element method (FEM) to solve the integro-differential equations of two-dimensional (2-D) time-harmonic eddy current problems for modeling the magnetic vector potential (MVP) distribution of multi-conductor systems in free-space environments. Various conductor configurations, including two and three, and six conductors, are studied to validate the effectiveness and applicability of this approach. To evaluate the accuracy of the proposed method, a comparative analysis was conducted against the IEC standard for the six-conductor system. The results demonstrate a minimum error of just 0.0066%, highlighting the method's excellent agreement with the IEC standard. Finally, this method not only enhances computational efficiency but also accurately captures the intricate behavior of electromagnetic fields within multi-conductor systems.
Keywords: Kernel RBF, finite element method (FEM), magnetic vector potential (MVP), eddy current, multiconductors.

Session D-5 – Quantum Engineering
Day 2 – 12 December, 2025 Friday
Time: 09:00 ~ 10:30; Venue: Room C010
Session Chair: Prof. Ivan Zelinka (VSB - Technical University of Ostrava, Czech Republic)
Co-session Chair: Assoc. Prof. Phuong T. Tran (Ton Duc Thang University, Vietnam)

№	Time	Paper Title
1	10:40 ~ 10:57	**Reliable Optimization Under Noise in Quantum Variational Algorithms** Vojtěch Novák, Silvie Illésová, Tomáš Bezděk, Ivan Zelinka, Martin Beseda
2	10:58 ~ 11:15	**Classical Optimization Strategies for Variational Quantum Algorithms: A Systematic Study of Noise Effects and Parameter Efficiency** Tomáš Bezděk, Haomu Yuan, Vojtěch Novák, Silvie Illésová, Martin Beseda
3	11:16 ~ 11:33	**From Classical to Hybrid: A Practical Framework for Quantum-Enhanced Learning** Silvie Illésová, Tomáš Bezděk, Vojtěch Novák, Ivan, Stefano Cacciatore, Martin Beseda
4	11:34 ~ 11:51	**On the Complementarity of Classical Convolution and Quantum Neural Networks in Image Classification** Silvie Illésová, Emmanuel Obeng, Tomáš Bezděk, Vojtěch Novák, Vittorio Cortellessa, Martin Beseda
5	11:52 ~ 12:10	**The Gaussian Paradox in mobile malware detection** Ladislav Dorotík, Milan Oulehla, Roman Šenkeřík, and Zuzana Komínková Oplatková
12:10 ~ 13:40		Lunch

Reliable Optimization Under Noise in Quantum Variational Algorithms

Vojtěch Novák[1,2], Silvie Illésová[6], Tomáš Bezděk[3], Ivan Zelinka[2,4], Martin Beseda[5]
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[6]*Gran Sasso Science Institute, L'Aquila, Italy*

Abstract. The optimization of Variational Quantum Eigensolver is severely challenged by finite-shot sampling noise, which distorts the cost landscape, creates false variational minima, and induces statistical bias called winner's curse. We investigate this phenomenon by benchmarking eight classical optimizers spanning gradient-based, gradient-free, and meta heuristic methods on quantum chemistry Hamiltonians H2, H4 chain, LiH (in both full and active spaces) using the truncated Variational Hamiltonian Ansatz. We analyze difficulties of gradient-based methods (e.g., SLSQP, BFGS) in noisy regimes, where they diverge or stagnate. We show that the bias of estimator can be corrected by tracking the population mean, rather than the biased best individual when using pop ulation based optimizer. Our findings, which are shown to generalize to hardware-efficient circuits and condensed matter models, identify adaptive metaheuristics (specifically CMA-ES and iL-SHADE) as the most effective and resilient strategies. We conclude by presenting a set of practical guidelines for reliable VQE optimization under noise, centering on the co-design of physically motivated ansatz and the use of adaptive optimizers.

Keywords: Differential evolution, evolutionary optimization, noisy optimization, quantum computing, variational quantum eigensolver

Classical Optimization Strategies for Variational Quantum Algorithms: A Systematic Study of Noise Effects and Parameter Efficiency

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Abstract. This study systematically benchmarks classical optimization strategies for the Quantum Approximate Optimization Algorithm when applied to Generalized Mean-Variance Problems under near-term Noisy Intermediate-Scale Quantum conditions. We evaluate Dual Annealing, Constrained Optimization by Linear Approximation, and the Powell Method across noiseless, sampling noise, and two thermal noise models. Our Cost Function Landscape Analysis revealed that the Quantum Approximate Optimization Algorithm angle parameters γ were largely inactive in the noiseless regime. This insight motivated a parameter-filtered optimization approach, in which we focused the search space exclusively on the active β parameters. This filtering substantially improved the performance of optimizers such as Constrained Optimization by Linear Approximation (reducing evaluations from 21 to 12 in the noiseless case, 58 to 27 with sampling noise, 57 to 35 with Thermal Noise-A) or for Pow ell Method (reducing evaluations from 149 to 78 in the noiseless case, 204 to 111 with sampling noise, 214 to 132 with Thermal Noise-A) and enhanced robustness, demonstrating that leveraging structural insights is an effective architecture-aware noise mitigation strategy for Variational Quantum Algorithms.
Keywords: Classical Optimization, Cost Function Landscape Analysis, Generalized Mean-Variance Problem, Noisy Intermediate-Scale Quantum (NISQ), Parameter-Filtered Optimization, Quantum Approximate Optimization Algorithm (QAOA), Variational Quantum Algorithms (VQAs).

From Classical to Hybrid: A Practical Framework for Quantum-Enhanced Learning

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Abstract. This work addresses the challenge of enabling practitioners without quantum expertise to transition from classical to hybrid quantum–classical machine learning workflows. We propose a three-stage framework: starting with a classical self-training model, then introducing a minimal hybrid quantum variant, and finally applying diagnostic feedback via QMetric to refine the hybrid architecture. In experiments on the Iris dataset, the refined hybrid model improved accuracy from 0.31 classical to 0.87 in quantum approach. These results suggest that even modest quantum components, when guided by proper diagnostics, can enhance class separation and representation

capacity in hybrid learning, offering a practical pathway for classical Machine Learning practitioners to leverage quantum-enhanced methods.
Keywords: Feature representation, hybrid quantum-classical learning, training diagnostics, variational quantum circuits, quantum machine learning.

On the Complementarity of Classical Convolution and Quantum Neural Networks in Image Classification
Silvie Illésová[1], Emmanuel Obeng[2], Tomáš Bezděk[3], Vojtěch Novák[4,5], Vittorio Cortellessa[2], Martin Beseda[2]
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Abstract. This work deals with the design of a hybrid classification model that uses two complementary parallel data processing branches. The aim was to verify whether the connection of different input representations within a common decision mechanism can support the stability and reliability of classification. The outputs of both branches are continuously integrated and together form the final decision of the model. On the validation set, the model achieved accuracy 0.9750, precision 1.0000, recall 0.9500 and F1-score 0.9744 at a threshold value of 0.5. These results suggest that parallel, complementary processing may be a promising direction for further development and optimization of the model, especially in tasks requiring high accuracy while maintaining robust detection of positive cases.
Keywords: Convolutional neural networks, hybrid models, image classification, quantum machine learning, quantum neural networks.

The Gaussian Paradox in mobile malware detection
Ladislav Dorotík[1], Milan Oulehla[1], Roman Šenkeřík[1], and Zuzana Komínková Oplatková[1]
[1]*Tomas Bata University in Zlín, Faculty of Applied Informatics, nám. T. G. Masaryka 5555, 760 01 Zlín, Czech Republic*

Abstract. While sophisticated machine learning algorithms typically outperform simpler approaches, we present a counterintuitive finding in Android malware detection: Gaussian Naive Bayes (GNB) demonstrates a 25.3% performance improvement when tested on temporally shifted malware samples. In contrast, all other evaluated algorithms show significant degradation ranging from 0.2 to 0.5 F1 points. Through an analysis of 10,000 bootstrap iterations across eight algorithms, we demonstrate that GNB achieves the F1 score of 0.930 on modern malware, compared to 0.742 on validation data ($\Delta F1 = -0.188$, $p < 0.00001$), while established algorithms including AdaBoost (0.985 validation F1) and SVM show 32.6% and 55.2% degradation respectively under identical tempo ral shift conditions. While the previous state-of-the-art studies, including TESSERACT [2], and Droid Evolver [3] have primarily focused on mitigating performance degradation under temporal distribution shifts, our finding of an improvement for GNB is, to our knowledge, the first documented case of performance enhancement for a simple probabilistic model under such conditions. We hypothesize that GNB's independence assumption prevents learning temporal artifacts, while its probabilistic modeling provides natural resilience to distribution shifts. Our findings suggest that in adversarial domains with temporal evolution, model simplicity can paradoxically be a source of robustness. Although the Contrasting dataset used may not align with typical deployment practices, it serves as a valuable diagnostic tool, exposing the overlooked resilience of simpler models such as GNB under temporal distribution shifts.
Keywords: Android, Gaussian Naive Bayes, malware detection, temporal robustness.

POSTER PRESENTATION

Day 1 – 11 December, 2025 Thursday

Session P: 16:05 ~ 16:20

Session P – Posters (Material Science – Control System – Computer Science – Renewable Energy)
Day 1 – 11 December, 2025 Thursday
Time: 16:05 ~ 16:20; Venue: Lobby Building A
Session Chair: Dr. Nguyen Huu Khanh Nhan (Ton Duc Thang University, Vietnam)
Co-Session Chair: Dr. Ha Duy Hung (Ton Duc Thang University, Vietnam).

№	Paper Title
1	**The impacts of titanium dioxide on color and luminous performances of white LEDs** Le Anh Tuan[1], Nguyen Thi Phuong Loan[2], Dang Truong Thinh[1], Ho Dang Sang[1], Nguyen Doan Quoc Anh[1] *[1]Faculty of Electrical and Electronics Engineering, Ton Duc Thang University, Ho Chi Minh City, Vietnam* *[2]Faculty of Fundamental 2, Posts and Telecommunications Institute of Technology, Ho Chi Minh City, Vietnam* **Abstract.** Creating novel red phosphor samples applicable to practical illumination ne-cessitates comprehending the methods of attaining luminescent enhancement via disparate processes. The study herein assesses Nb joint-doping as well as NH_3 processing for $CaTiO_3$:Pr (CTOP) samples, uncovering the workings behind the luminescent enhancement. Said samples were made via the con-ventional solid-state (SS) approaches while the fluorescent attribute was as-sessed in terms of viable utilization for fluorescent illumination. The fluorescent lifetime was assessed then utilized for tracking alterations for trap status via the Nb^{5+} joint-doping within the samples. Computations were conducted for identifying the beneficial faults in terms of energy. Based on outcomes, Nb^{5+} joint-doping lessens the quantity of surplus oxygen trap statuses abat-ing the fluorescent. In addition to CTOP, titanium dioxide (TiO_2) was used, and its effect on optical properties in LEDs, such as scattering coefficient, YAG:Ce phosphor dosage, correlated color temperature (CCT), chroma aber-ration, lumen, CQS, and CRI, was investigated. **Keywords:** White LED, Lambert-Beer law, color rendering index, luminous efficacy, TiO_2.
2	**Inverse Prandtl Ishlinskii Based Control Approach for a Pneumatic Artificial Muscle Driven Manipulator** Đinh Văn Vương[1], Lê Tuấn Anh[2], Đào Quý Thịnh[2] *[1]Department of Control and Automation, Electric Power University, No.235 Hoang Quoc Viet, Ha Noi, 11917, Ha Noi, Viet Nam.* *[2]School of Electrical and Electronic Engineering, Hanoi University of Science and Technology, No.01 Dai Co Viet, Ha Noi, 11615, Ha Noi, Viet Nam* **Abstract.** Pneumatic Artificial Muscles (PAMs) provide notable advantages, including a high power-to-weight ratio and intrinsic compliance, making them well-suited for human-interactive applications. However, their highly nonlinear and hysteretic characteristics create major challenges in modeling and control. This paper proposes a control approach that combines an inverse Prandtl–Ishlinskii (PRIS) model with a Proportional–Integral (PI) controller to effectively compensate for hysteresis and improve trajectory tracking in PAM-based actuators. The inverse PRIS model is derived from the original PRIS formulation and utilized as a feedforward compensator, operating alongside a conventional PI controller in a closed-loop feed-back scheme. The proposed hybrid controller is experimentally validated using sinusoidal and triangular reference trajectories. Results demonstrate that the approach significantly enhances tracking accuracy, highlighting its potential for application in rehabilitation robotics employing PAM-based actuators. **Keywords:** Pneumatic Artificial Muscle, Prandtl Ishlinskii Model, Particle Swarm Opti-mization, Antagonistic muscle, Root Mean Square Error, Proportional Integral.
3	**Artificial Intelligence and Personal Trust Index Integration in Blockchain-Based DeFi Risk Management** Quoc Tran-Nam[1], Tuyet Ngoc Nguyen[2] *[1]Ho Chi Minh University of Banking, Ho Chi Minh City, Vietnam*

	[2]*University of Economics Ho Chi Minh City, Ho Chi Minh City, Vietnam* **Abstract.** This study proposes a conceptual framework for regulated DeFi risk man-agement in Vietnam, integrating Artificial Intelligence (AI) and the Personal Trust Index (PTI) on top of the VNeID and NDAChain digital identity infra-structures. The model features a multi-layered AI pipeline for monitoring transactions, anomaly detection, and adaptive control, reflecting best-practice syntheses adapted for Vietnam's fragmented datasets and evolving legal context. Unlike existing state-of-the-art approaches such as Chainalysis or MAS Singapore, which rely primarily on on-chain analytics or static eKYC, this framework explicitly combines dynamic personal trust scoring with real-time identity verification and compliance, resulting in integrated risk profiling. Comparative analysis indicates that the proposed AI - PTI - DeFi system theoretically overcomes major limitations of current frameworks, particularly in legal auditability, adaptive deployment, and multi-sandbox flexibility. The model establishes a reference point for future re-search and practical guidance on launching cross-sector sandboxes, data standards, and transparent DeFi governance for emerging markets. **Keywords:** Decentralized Finance (DeFi), Artificial Intelligence (AI), Personal Trust Index (PTI), Digital Identity, Blockchain.
4	**Designing an Ontology-Based Knowledge Retrieval System in Knowledge Domain of Internet of Things** Thanh Dien Nguyen[1] [1]*Department of CF, FPT University, Ho Chi Minh City, Vietnam* **Abstract.** This paper presents the design of an ontology-based knowl- edge retrieval system for the Internet of Things (IoT) domain. The proposed system employs a semantic knowledge model, IoT-ONTO, to rep- resent various types of knowledge in the IoT field, such as knowledge about circuit boards, sensor types, operating principles, and the seman- tic relationships among them within IoT environments. Unlike traditional data retrieval models, our approach integrates contextual information, device capabilities, and event-driven reasoning to enhance the precision and relevance of retrieved knowledge. IoT data and knowledge entities are represented as interconnected concept graphs, enabling se- mantic similarity computation between user queries and domain knowl- edge through ontology-based reasoning algorithms. An intelligent query analysis mechanism further refines the understanding and interpretation of user intents. Experimental evaluation using real-world IoT datasets demonstrates that the proposed system achieves high retrieval accuracy and scalability, outperforming keyword-based and relational approaches. These results confirm the effectiveness of the ontology-driven framework in providing intelligent, context-aware, and semantically rich knowledge retrieval for IoT applications. **Keywords:** Knowledge representation, Ontology-based knowledge retrieval, Internet of Things, Semantic similarity, Knowledge graph.
5	**Proposed Algorithm to Find the Reliability of 2-Terminal and K-Terminal Networks** Haider Saleh Howeidi[1] and Zahir Abdul Haddi Hassan[1] [1]*Department of Mathematics, College of Education for Pure Sciences, University of Babylon, Iraq* **Abstract.** This paper presents a novel algorithm for evaluating the reliability of both 2-terminal and K-terminal networks. The proposed method partitions a given network into sub-networks and applies a top-down reliability analysis to each partition, taking into account the number of source (input) and sink (output) nodes. Unlike traditional techniques that require analyzing the entire system, the algorithm performs basic operations on selected partitions, which simplifies the computational process. The effectiveness of the approach is demonstrated on series, parallel, mixed, and complex topologies. Comprehensive comparisons with classical methods—including the Cut Method, Inclusion–Exclusion, Sum of Disjoint Product (SDP), and Path tracing Method PTM-highlight that the proposed algorithm achieves equivalent accuracy while keeping reasonable execution times. The results confirm its suitability for large-scale systems such as telecommunication networks, power distribution grids, and cloud infrastructures. Overall, the

	algorithm provides a practical and scalable framework for reliability assessment across diverse network applications. **Keywords:** Reliability network, K-Terminal, minimal path, complex, mixed.
6	**Deep Convolutional Neural Network for Automated Diagnosis of Mango Leaf Diseases** Ducthinh Nguyen[1] and Leminhthien Huynh[2] *[1]Faculty of Data Science, University of Finance – Marketing, Ho Chi Minh City, Vietnam* *[2]Faculty of Engineering and Technology, Saigon University, Ho Chi Minh City, Vietnam* **Abstract.** This study presents a deep-learning-based framework for the automated diagnosis of seven common mango leaf diseases using a curated dataset of 4,800 real-field images collected in Vietnam. A lightweight Convolutional Neural Network (CNN) was designed and trained to classify mango leaf images under natural variations in illumination, background, and leaf orientation. The proposed model achieved a test accuracy of 97.60%, significantly outperforming traditional machine-learning classifiers, including Support Vector Machine (82.71%) and Random Forest (81.35%), thereby confirming the superiority of deep feature extraction for complex visual disease patterns. Robustness was further validated using five-fold cross-validation, confusion matrices, and class-wise performance metrics. The results demonstrate that the proposed CNN provides an effective, computationally efficient solution suitable for deployment on mobile and edge devices, enabling real-time field diagnosis and supporting precision agriculture practices. **Keywords:** Mango leaf diseases, Deep learning, Convolutional Neural Network (CNN), Image classification, Plant disease detection.
7	**Predicting Student Academic Performance Using Machine Learning Based on LMS Behavioral Data** Nguyen Le Anh Tu[1], Nguyen Quang Huy[1], Nguyen Khoi Nguyen[1], Nguyen The Triet[1], and Nguyen Thanh Dien[1] *[1]FPT University, Ho Chi Minh Campus, Vietnam* **Abstract.** This study investigates the use of machine learning techniques to predict student academic performance using behavioral interaction data collected from a Learning Management System (LMS). Four widely used algorithms—Decision Tree (J48), Random Forest, Support Vector Machine (SVM), and Neural Network—were trained and evaluated on the public xAPI-Edu-Data dataset. The models were assessed using accuracy, F1-score, and computational time to provide a balanced evaluation of predictive capability and practical feasibility. Results show that the Neural Network achieved the highest accuracy (79.37%), followed by SVM (78.75%), Random Forest (76.67%), and Decision Tree (75.83%). Compared with existing state-of-the-art studies using similar datasets, our findings fall within the top reported accuracy range while providing a more comprehensive comparison across model interpretability and resource consumption. The results demonstrate the effectiveness of LMS behavioral indicators for academic performance prediction and highlight the trade-off between predictive accuracy and interpretability, offering valuable insights for future LMS-integrated early-warning systems. **Keywords:** Learning management system, machine learning, neural network, educational data mining, students.
8	**Applying Knowledge Management Model to Enhance Information Retrieval in Java Language Data Structure and Algorithm Domain** Nguyen Hung Cuong[1], Ho Nguyen Khoi Nguyen[1], Vo Ngoc Minh Thu[1], Nguyen Huynh Hoang Uyen[1], Nguyen Thanh Dien[1] *[1]FPT University, Ho Chi Minh Campus, Vietnam* **Abstract.** This study proposes a novel integration of Knowledge Management (KM) and Information Retrieval (IR) tailored to the Java Data Structures & Algorithms (DSA) domain. Our approach uses a Java-DSA ontology and semantic, code-aware indexing to model relationships among algorithms, data structures, complexity, and implementations. A working prototype

	(ontology-based knowledge base + semantic retrieval engine) is implemented and compared against baseline systems (e.g., Google or StackOverflow) using metrics such as precision, recall, response time, and user satisfaction. Results show that our approach improves retrieval relevance and supports better conceptual learning. The contributions are threefold: (1) a domain-specific ontology for Java-DSA, (2) a hybrid KM–IR retrieval pipeline aware of code semantics, and (3) empirical evidence that domain-aware KM improves retrieval relevance and supports learning. Keywords: Java, Data Structures & Algorithms, Knowledge Management, Information Retrieval, Ontology, Semantic Search, Code-aware Retrieval, Prototype Evaluation. **Keywords:** Java, data structures & algorithms, knowledge management, information retrieval, ontology, semantic search, code-aware retrieval, prototype evaluation.
9	**Probabilistic Day-Ahead Solar Power Forecasting Using DeepAR with Meteorological Data Integration: A Case Study of Dau Tieng 1 Solar Farm, Vietnam** Trung Thong Hoang[1], Nam Anh Tran[2], Anh Hai Tran[3], and Hung Nguyen[1] *[1]HUTECH Institute of Engineering, HUTECH University, Ho Chi Minh City, Vietnam* *[2]Department of Industrial Electricity, Ly Tu Trong College of Ho Chi Minh City* *Ho Chi Minh City, Vietnam* *[3]Binh Thanh Vocational College, Ho Chi Minh City, Vietnam* **Abstract.** Day-ahead photovoltaic (PV) power forecasting is essential for reliable grid operation in systems with high renewable penetration. Traditional statistical models struggle to capture the nonlinear and stochastic nature of PV genera-tion, especially under rapidly changing tropical weather. This study develops a high-resolution (5-minute) probabilistic forecasting framework based on DeepAR with Beta likelihood for the 150 MW Dau Tieng 1 solar farm in Vietnam. We benchmark DeepAR against PatchTST, Prophet, and Persistence baselines. To address the absence of numerical weather prediction (NWP) forecasts, we introduce Textured Persistence—a volatility-aware covariate generation method that blends daily profiles, weekly climatology, and regime-dependent stochastic noise. Results over five test days in December 2024 show that DeepAR achieves competitive deterministic performance (MAE reduction of 35% vs. Persistence, 21% vs. Prophet, 7.5% vs. PatchTST) and superior probabilistic accuracy with the lowest CRPS. Applying Adaptive Conformal Inference substantially improves interval coverage from 49% to 81% while maintaining practical sharpness. An ablation study confirms that textured persistence, volatility features, and clear-sky normalization contribute significantly to accuracy. This work demonstrates a practical, well-calibrated, deployment-ready framework for operational day-ahead PV forecasting in tropical monsoon climates. **Keywords:** Solar power forecasting, DeepAR, probabilistic forecasting, adaptive confor-mal inference, uncertainty quantification.
10	**Solution for monitoring and improving CO_2 concentration in classroom: a Multi-Layer Perceptron Approach** Oanh Tran Thi Hoang[1], Hung Nguyen Xuan[2], Ngoc Nguyen Quang[2], and Phu Nguyen Ngoc[3] *[1]Binh Duong Economics and Technology University, Ho Chi Minh City, Vietnam* *[2]Posts and Telecommunications Institute of Technology, Hanoi Capital, Vietnam* *[3]Van Lang University, Ho Chi Minh City, Vietnam* **Abstract.** The paper presents a solution to monitor and improve CO_2 concentration in the classroom through an AIoT system integrating the MH - Z19B CO2 gas sensor, DHT11 temperature - humidity sensor and Raspberry Pi camera connected to Raspberry Pi 3 hardware. The current temperature, humidity, CO_2 gas data and the number of people collected in a 70 m2 classroom are continuously sent to ThingSpeak for analysis and forecasting the CO_2 concentration in the classroom using the Multi-Layer Perceptron (MLP) model. The forecasted CO_2 gas concen-tration results help to issue early warnings and control the fan device when the CO_2 concentration is expected to be greater than 1200 ppm to maintain safe air quality in the classroom, improving the concentration and health of learners. The system has been tested in real classroom conditions, showing 98.21% accuracy in predicting CO_2 concentration in the classroom. This solution

contributes to supporting smart classroom environment management, saving energy and improving teaching efficiency.
Keywords: AIoT, MLP, CO_2 prediction, smart classroom.