

2026 Nineteenth International Conference on Sensing Technology (ICST2026)

Macquarie University, Sydney, Australia | December 7-9, 2026

Programme & Abstract Book

Organized by:



MACQUARIE University
SYDNEY·AUSTRALIA

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WELCOME MESSAGE

It is our great pleasure to welcome you to the 19th International Conference on Sensing Technology (ICST2026), held from 7-9 December 2026 at Macquarie University, Sydney, Australia. The conference is hosted by the School of Engineering and takes place at the University's beautiful Wallumattagal Campus in North Ryde.

ICST2026 marks the nineteenth conference in the International Conference on Sensing Technology series. Since its inception, ICST has provided a globally recognized forum for researchers, engineers, scientists, and industry practitioners to share advances and innovations in sensing technologies and their applications.

The first two conferences (2005 and 2007) were held at Massey University, New Zealand. Subsequent conferences were hosted by distinguished institutions around the world, including National Cheng Kung University, Taiwan (2008); the University of Salento, Italy (2010); Massey University, New Zealand (2011 and 2013); Kolkata, India (2012); Liverpool John Moores University, United Kingdom (2014); Auckland, New Zealand (2015); Nanjing, China (2016); Sydney, Australia (2017); and the University of Limerick, Ireland (2018). Due to the COVID-19 pandemic, the conference was not held during 2020 and 2021. ICST2022 was organized online by the Indian Institute of Technology Madras, India. The fifteenth conference was hosted by Macquarie University, Sydney, in 2022, followed by ICST2023 in Hyderabad, India. The seventeenth conference was held at Macquarie University, Sydney, in December 2024, while the eighteenth conference was organized by Utsunomiya University and held at the Tochigi Prefectural Cultural Centre, Utsunomiya, Japan, in December 2025.

This year's conference features 66 technical papers presented over three days. We would like to congratulate all authors for their valuable contributions and thank them for helping make ICST2026 a vibrant and successful scientific event.

Sensing technology continues to play a pivotal role in addressing many of society's most pressing challenges. Its applications span a wide range of fields, including healthcare and medical diagnostics, industrial automation and manufacturing, environmental monitoring, transportation, defense and national security, disaster prevention, and smart infrastructure. High-performance sensors, combined with advanced signal processing and intelligent data analytics, enable early detection of critical events and contribute to safer and more sustainable communities. As sensing technologies continue to evolve, there is an increasing need for collaboration among researchers and practitioners from both technologically advanced and developing nations in the design, fabrication, deployment, and application of innovative sensing systems.

We sincerely hope that ICST2026 provides an excellent platform for exchanging ideas, fostering collaborations, and discussing the latest scientific and technological advancements in sensing technology.

On behalf of the Organizing Committee, we extend our sincere gratitude to all individuals and organizations who have contributed to the success of this conference. We would especially like to thank all authors, whose research contributions form the foundation of this event. We are deeply grateful to the members of the Technical Program Committee and all reviewers for their dedication, expertise, and hard work in maintaining the high quality of the conference program.

We would also like to express our special appreciation to our distinguished keynote speakers, Prof. Wei Chen from the University of Sydney, Australia; Prof. Maitreyee Roy from the University of New South Wales, Australia; and Dr. Michael Ruppert from the University of Technology Sydney, Australia, for generously sharing their expertise and supporting the conference. We would also like to extend our sincere thanks to Dr. Abhijeet Gorey, TCS Research, India, Prof. Devi Prasad Mishra, Indian School of Mines, Dhanbad, India and Prof. Gang-Ding Peng, UNSW, Sydney, Australia for organizing a special session on Intelligent Sensing System for Sustainable Mining and Mineralogy

Our sincere thanks are also extended to our financial sponsors and supporters, including Macquarie University, MDPI Sensors, IEEE and IEEE NSW section, IEEE NSW Sensors Council and IMS chapters, for their valuable technical and financial support.

We firmly believe that ICST2026 will provide an outstanding forum for discussing emerging scientific and technological challenges in sensing technology. We hope that the interactions among participants will be stimulating, productive, and rewarding, leading to new collaborations and future innovations.

Finally, we wish all participants an enjoyable conference experience and a pleasant stay in Sydney. We hope you enjoy your time in Australia and take full advantage of the opportunities for networking, learning, and collaboration that ICST2026 offers.

S. C. Mukhopadhyay
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KEYNOTE SPEAKER

Transforming Eye Care with Artificial Intelligence

Associate Professor Maitreyee Roy, University of New South Wales, Australia

Abstract:

The eye provides a unique window into both vision and overall health, creating new opportunities for non-invasive sensing and precision medicine. Advances in optical sensing technologies, including optical coherence tomography (OCT), retinal imaging, interferometric imaging, wavefront sensing, and quantitative optical metrology, have significantly improved our ability to visualise and measure ocular structure and function. At the same time, artificial intelligence (AI) is transforming these rich imaging datasets into clinically meaningful information that supports diagnosis, prognosis, and personalised patient care.

This presentation explores the evolution from precision optical sensing to clinical intelligence, highlighting how advances in photonics, biomedical imaging, and AI are transforming modern eye care. The talk will demonstrate how AI can extract clinically relevant information from ocular images to support the early detection and monitoring of ocular diseases, while also revealing biomarkers associated with systemic health. It will also discuss the growing role of intelligent image analysis, quantitative optical measurement, and clinically validated sensing technologies in enabling trustworthy AI for healthcare.

By integrating advanced optical sensing with artificial intelligence, eye care is evolving beyond image acquisition towards intelligent clinical decision support and personalised medicine. This convergence of sensing technology, optical physics, biomedical engineering, and AI has the potential to improve diagnostic accuracy, expand access to healthcare, and enable earlier detection of both ocular and systemic diseases.

Author's Short Biography:



Associate Professor Maitreyee Roy is an optical physicist in the School of Optometry and Vision Science at the University of New South Wales (UNSW), Australia. With over 20 years of experience spanning academia, government, and industry, her research focuses on optical sensing, optical instrumentation, biomedical imaging, optical coherence tomography, optical metrology, and artificial intelligence, translating advances in optical science into AI-enabled healthcare.

Professor Roy leads the Optical Radiometry Laboratory (ORLAB) at UNSW, Australia's leading NATA-accredited optical radiometry laboratory within a university. ORLAB provides nationally recognised optical measurement, calibration, and testing services for industry, government, and research, while supporting Australian and international standards development in optical and ophthalmic technologies.

Her research integrates advanced optical sensing and AI to develop intelligent diagnostic systems for the early detection and monitoring of ocular diseases and to identify biomarkers of systemic health from retinal images. She has made significant contributions to optical imaging, sensing, and AI through her research, international collaborations, and leadership in standards development. Her work bridges optical engineering, sensing technology, and artificial intelligence to advance precision medicine through intelligent, non-invasive diagnostic technologies.

KEYNOTE AND INDUSTRY SPEAKER

ParkPilot: A Smart and Environment-friendly Vehicle Parking

Dr. Arindam Pal, CEO and Director, TechSoftX Corporation, Sydney, Australia

Abstract:

Parking is a difficult problem for urban travellers in big cities like Sydney, Melbourne, Adelaide, and Brisbane. In most busy areas like malls, supermarkets, airports, and train stations, parking is limited, and it is quite challenging to assign the available parking spots during peak times in a timely and efficient manner. Three main problems arise from this. Drivers waste time, fuel, and money searching for free parking spaces. Parking operators lose revenue because drivers can't find available parking spaces. Unnecessary carbon is emitted due to wastage of fuel, resulting in the pollution of the environment.

We introduce ParkPilot to solve these problems. ParkPilot consists of a mobile app client and a server on the cloud. It applies techniques from data science and machine learning, along with sensors, cameras, and scalable database and storage systems to give high-quality experience to the drivers, the parking operators, and the environment. For drivers, it saves time, fuel, and money and also reduces their stress and anxiety when finding available parking spaces. For parking operators, it maximises parking lot utilisation, thereby maximizing the generated revenue. For the environment, it reduces fuel consumption, reducing the carbon emission footprint of the parking lot (which can be traded in a carbon market).

Author's Short Biography:



Arindam Pal is the Chief Executive Officer, Director, and Founder of TechSoftX Corporation. TechSoftX is the next generation software company. The company develops products, provide consulting, training, services, support, and partner with other companies to sell their products and services. Previously, he was a Director of Data Science and Optimization at Optym, where he made transportation companies more profitable and efficient using optimization and AI. He was also a Conjoint Senior Lecturer in the School of Computer Science and Engineering at UNSW Sydney. His research interests are in Algorithms, Artificial Intelligence, Data Science, Optimization, and Machine Learning.

He has more than 19 years of industrial research experience in Data Science, Machine Learning, Cyber Security, and Optimization, working for world-class companies like Microsoft, Yahoo!, Novell, CSIRO, Cognizant, Optym, and TCS Research. He has managed and delivered high-quality software and impactful projects in Australia, US, and India. He is a leader in algorithms, data science, optimization, and machine learning. He has published academic papers in reputed conferences and journals, and was granted patents in various countries like India, USA, and Europe. He is a technical programme committee member for several reputed conferences and technical reviewer for many renowned journals. He earned his Ph.D. in Computer Science from the Indian Institute of Technology Delhi. He is a Senior Member of both ACM and IEEE.

KEYNOTE SPEAKER

Smart Sensing and AI for Healthcare

Professor Wei Chen, University of Sydney, Australia

Abstract:

Many challenges exist in health monitoring and management, such as continuous, accurate, and comfortable monitoring of multi-parameters, early detection and warning of diseases, as well as the interaction with environments. The challenges in healthcare raise health risks and impose significant economic and social burden. Thus, seeking innovative solutions and new technologies to address these issues is very important. The development of modern sensors, Internet of Things, advanced materials, machine learning and AI technology has inspired the innovation on intelligent designs for healthcare.

The novel intelligent wellness sensing platforms seamlessly integrate smart sensing technologies, data fusion techniques, advanced materials, and clinical knowledge. Physiological signs, behaviors and environmental information can be obtained effectively. By jointly analyzing physiological and behavioral parameters with environmental interaction information and using data fusion technology, the health-related activities can be identified, predicted and evaluated. With intelligent wellness sensing platform, personal health monitoring and forecasting will be provided assisting in developing personalised healthcare and health management plan, guiding people towards a healthier lifestyle. The multidisciplinary research on smart sensing and AI for healthcare will bring new development for improving the quality of life for people ranging from babies to aging population during their everyday life and have significant social impact.

Author's Short Biography:



Prof. Wei Chen is Head of School of Biomedical Engineering and Professor at the University of Sydney, Australia. She obtained her Ph.D. degree in 2007 from the University of Melbourne in Australia and her bachelor's and master's degrees from Xi'an Jiaotong University in China. She worked at Bell Laboratories Germany, Alcatel-Lucent, Stuttgart, Germany as an intern in 2005. From 2007 to 2015, she was an Assistant Professor and served as Chair of Theme Health at Eindhoven University of Technology in the Netherlands. From 2015 to 2023, she worked as a full Professor and Director of Center of Intelligent Medical Electronics at School of Information Science and Technology and Director of the Physiological Signal and Sleep platform in the Human Phenome Institute at Fudan University in Shanghai.

She serves as the IEEE EMBS (Engineering Medicine and Biology Society) AdCom Asia/Pacific representative, Associate Editor of IEEE Transactions on Biomedical Engineering, IEEE Journal on Biomedical Health Informatics, IEEE Transactions on Neural Systems and Rehabilitation Engineering and IEEE Journal of Translational Engineering in Health and Medicine. From 2020 to 2022, She was the Chair of IEEE Sensor and Systems

Council China Chapter and Managing Editor of IEEE Reviews in Biomedical Engineering. She has published 2 books, 200+ scientific papers, holds 20+ granted patents, and successfully led 10+ important R&D projects. Her research focuses on biomedical unobtrusive sensor systems and health informatics, including wearable sensor systems, physiological and behavioral data sensing and analysis, multimodal approaches for health modulation, artificial intelligence for biomedical engineering, neonatal monitoring, brain health, smart rehabilitation and sleep monitoring.

INVITED SPEAKER

Design and Control of Microelectromechanical Systems for Scanning Probe Microscopy

Dr Michael Ruppert, University of Technology Sydney, Australia

Abstract:

The microcantilever is a cornerstone microelectromechanical systems (MEMS) device whose precision, versatility, and scalability have underpinned major advances in nanotechnology over the past three decades. It forms the core of numerous nanoscale interrogation and manipulation platforms including atomic force microscopy (AFM), scanning probe lithography, and high-resolution mass sensing, where its dynamic behaviour directly governs measurement fidelity and throughput. Despite its seemingly simple geometry, the fast, nonlinear dynamics that arise during micro- and nanoscale interactions continue to motivate intensive research in device design, instrumentation, system identification, and control. In this talk, I will present our progress in integrating actuation and sensing directly at the MEMS chip level, enabling new capabilities in precision instrumentation and feedback control. I will highlight how these advances open pathways to next-generation scanning probe techniques, including multifrequency AFM, single-chip AFM architectures, tip-enhanced Raman spectroscopy, and low-temperature ultra-high-vacuum AFM, ultimately pushing the limits of nanoscale measurement and manipulation.

Author's Short Biography:



Dr Michael Ruppert is currently a senior lecturer in Mechatronics at the University of Technology Sydney. He is the Research Theme Lead for Microsystems and Mechatronics at the UTS Centre for Audio, Acoustics and Vibration and Director of the Micro and Nanomechatronic Systems Lab at UTS TechLab. Previously, he was a postdoctoral researcher and research associate at the University of Newcastle, Australia and a visiting researcher with the Mechanical Engineering Department at the University of Texas at Dallas, USA. He received the Dipl.-Ing. degree in automation technology, with a specialization in systems theory and automatic control, from the University of Stuttgart, Germany, in 2013. In 2017, he received the PhD degree with Excellence Award in electrical engineering from The University of Newcastle, Australia.

To date, Dr Ruppert's work has resulted in over 60 publications including 2 book chapters, 36 journal articles, and 16 fully refereed conference proceedings. For his contributions to the field, he received prestigious awards including the 2018 IEEE Transactions on Control Systems Technology Outstanding Paper Award, the 2019 Best Conference Paper Award at the International Conference on Manipulation, Automation and Robotics at Small Scales, he was named a 2021 Fresh Scientist for NSW and he received the 2022 University of Newcastle Early Career Researcher Award. Dr Ruppert has received over \$3.5 million in academic research funding and more than \$500,000 in direct research funding from industrial partners. He is currently a 2024 ARC DECRA fellow and a chief investigator on a 2024 ARC Discovery Project and a 2025 ARC LIEF project.

SPECIAL SESSION

Intelligent Sensing System for Sustainable Mining and Mineralogy

Session S9A, Wednesday 9 December, 09:00-10:30

Organisers:

Dr Abhijeet Gorey, Scientist, TCS Research, India
Prof. Devi Prasad Mishra, Dept. of Mining Engineering, Indian Institute of Technology (Indian School of Mines), Dhanbad, India
Prof. Gang-Ding Peng, School of Electrical Engineering and Telecommunications, UNSW, Sydney, Australia

Description:

The global mining and mineral industry is undergoing rapid transformation driven by the clean energy transition and the growing demand for critical minerals. As mining extends into deeper and more complex environments, challenges related to worker safety, ground stability, equipment interactions, and environmental risks are increasing. This session invites contributions on advanced sensing technologies—including ultrasound, optical, geotechnical, gas detection, ventilation monitoring, communication systems, and autonomous inspection platforms—that enable real-time monitoring, enhanced situational awareness, and proactive risk management for safer and more sustainable mining operations.

A central focus is the integration of AI-powered sensing through sensor fusion, deep learning, and edge analytics to improve hazard detection, equipment health monitoring, and operational decision-making. The session will also address environmental challenges such as tailings risks and spontaneous coal combustion, highlighting emerging technologies including EM/RF, hyperspectral imaging, satellite-based deformation tracking, and photoacoustic monitoring for continuous environmental oversight. By bringing together researchers, innovators, and industry leaders, the session will showcase how intelligent sensing is enabling safer, greener, and future-ready mining systems.

ICST 2026 PROGRAMME AT A GLANCE

MONDAY, 7TH DECEMBER

Time	Event	
09:00-09:30	S0: Opening session [14SCO T2]	
09:30-10:00	Morning Tea	
10:00-11:30	S1A: Battery and EV Sensing [14SCO T2]	S1B: Sensors for Physiological Monitoring [14SCO T3]
11:30-11:40	Break Time	
11:40-13:10	S2A: IoT and Remote Sensing [14SCO T2]	S2B: Capacitive and Magnetic Sensing [14SCO T3]
13:00-14:00	Lunch	
14:00-15:12	S3A: Thermal and Mechanical Sensing [14SCO T2]	S3B: Radar Sensing [14SCO T3]
15:15-15:45	Afternoon Tea	
15:45-17:15	S4A: Online Session #1 [14SCO T2]	S4B: Sensing related to Motors, Robots and Drones [14SCO T3]

TUESDAY, 8TH DECEMBER

Time	Event	
08:30-09:00	Late Registration	
09:00-10:30	S5: Keynote #1 and #2 [14SCO T2]	
10:30-11:00	Morning Tea	
11:00-12:30	S6: Keynote #3 and #4 [14SCO T2]	
12:30-13:30	Lunch	
13:30-15:00	S7A: Wearable Sensors and Activity Monitoring [14SCO T2]	S7B: Image Sensing [14SCO T3]
15:00-15:30	Afternoon Tea	
15:30-17:18	S8A: Bio-Sensing [14SCO T2]	S8B: Online Session #2 [14SCO T3] (ends 17:00)
18:30-22:00	Banquet Dinner at Lakeside Hotel & Conference Centre	

WEDNESDAY, 9TH DECEMBER

Time	Event	
09:00-10:30	S9A: Intelligent Sensing System for Sustainable Mining and Mineralogy - Special session [14SCO T2]	S9B: Sensors for Challenging Applications [14SCO T3]
10:30-11:00	Morning Tea	
11:00-12:30	S10A: Sensor Applications [14SCO T2]	S10B: Women in Sensing Workshop [14SCO T3]
12:30-13:30	Lunch Time	
13:30-15:00	S11: Closing Ceremony and Award [14SCO T2]	

VENUE

ICST 2026 will be held at:
14 Sir Christopher Ondaatje Avenue (14SCO), Theatres T2 and T3
Macquarie University, Wallumattagal Campus
North Ryde, NSW 2109, Australia

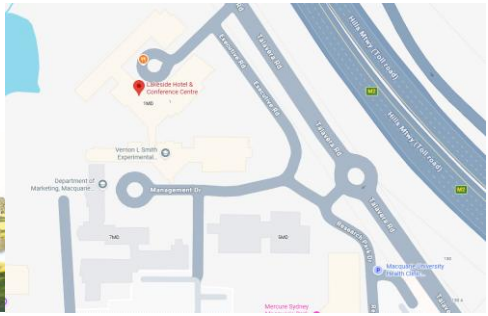
WI-FI ACCESS

Please use the following information for accessing the event's Wi-Fi network.
Network Name: Macquarie Events
Browse to: www.mq.edu.au (you will be redirected to enter the passcode)
Passcode: icst2026
Valid: 7 December, 8:00 am – 9 December, 5:00 pm

BANQUET

Banquet Dinner at Lakeside Hotel & Conference Centre
Tuesday, 8 December 2026, 6:30 pm – 10:00 pm
Address: 1 Executive Road, Macquarie Park NSW 2113 (Macquarie University campus)





TECHNICAL PROGRAMME

MONDAY, DECEMBER 7TH

9:00 to 9:30

S0: OPENING SESSION

Room: 14SCO T2

Chair: Mohsen Asadnia (Macquarie University, Australia)

10:00 to 11:30

S1A: BATTERY AND EV SENSING

Room: 14SCO T2

Chair: Mohsen Asadnia (Macquarie University, Australia)

10:00 Intelligent Sensor-Based Battery Digital Twin for Predictive Health Management of Electric Vehicle Battery Systems

Hemanthasai Madugula (Woxsen University, India); Sujit Singh (Woxsen University, India); Venkat Reddy Muppani (The Labour Relations Institute Hyderabad, India)

Electric vehicle (EV) batteries require continuous monitoring to ensure operational safety, reliability, and extended service life. Conventional Battery Management Systems (BMS) primarily perform real-time monitoring but provide limited capability for predictive health assessment and early fault detection. This paper proposes an Intelligent Multi-Sensor Battery Digital Twin (IMSBDT) framework that integrates multisensor data acquisition, Internet of Things (IoT) communication, Digital Twin technology, and Explainable Artificial Intelligence (XAI) for predictive battery health management. The proposed framework utilizes synchronized measurements from voltage, current, temperature, humidity, and internal resistance sensors to construct a real-time virtual representation of the physical battery. A Light Gradient Boosting Machine (LightGBM) model is employed to estimate key battery health indicators, including State of Charge (SOC), State of Health (SOH), Remaining Useful Life (RUL), and thermal fault risk, while SHapley Additive exPlanations (SHAP) provide model interpretability through feature importance analysis. The framework is validated using a publicly available lithium-ion battery dataset and compared with conventional machine learning models. Experimental results demonstrate that the proposed approach achieves superior prediction accuracy, lower estimation error, and improved reliability for battery health monitoring. The proposed IMSBDT framework provides an efficient and scalable solution for next-generation intelligent Battery Management Systems, enabling real-time monitoring, predictive maintenance, enhanced operational safety, and improved battery lifecycle management for smart electric mobility applications.

10:18 Single-Coil PCB Eddy Current Sensor for Defect Detection in Aluminum

Rachael Tighe (University of Waikato, New Zealand); Robert N Dean (Auburn University, USA & University of Waikato, New Zealand); Emily C. Hatfield (Auburn University, USA)

Early non-destructive detection of cracks is paramount to preventing catastrophic failure in mechanical systems. To accomplish this, a simple low-cost single-coil PCB eddy current sensor was developed. Testing demonstrated that the sensor could successfully detect cracks and notches of various sizes in aluminum (Al6060). The sensor demonstrated a sensitivity of 1.0985 μH/mm for measuring notch depth in aluminum. For detecting a crack in aluminum, the sensor's sensitivity increased nonlinearly from 3.0154 μH/mm for a very narrow crack to 17.1824 μH/mm at a crack width of 2.5 mm.

10:36 Sensor-Based Battery Monitoring for Techno-Economic Assessment of Rural EV Charging Infrastructure

Aishvaria Gorityala (BITS-Pilani, Hyderabad Campus, India); Radhika Sudha (Birla Institute of Technological Sciences, Pilani, Hyderabad Campus, India); Ankur Bhattacharjee (Birla Institute of Technology and Science Pilani, Hyderabad Campus, India); Joyjit Mukherjee (BITS Pilani Hyderabad Campus, India); Rishi Kumar (Birla Institute of Technology and Science (BITS) Pilani, India); Sara Deilami (Macquarie University, Australia)

Electric vehicle (EV) adoption in rural regions requires charging infrastructure that is economically feasible while satisfying practical charging requirements. Most techno-economic assessments rely on assumed charging demand profiles, which may not accurately represent real battery usage. This study presents a sensor-based framework for the techno-economic evaluation of a rural EV charging station developed for the retrofitted SAARATHI electric two-wheeler. A Daly Smart Battery Management System (BMS) with integrated sensor technology continuously recorded battery voltage, current, State of Charge (SOC), temperature, power, and remaining capacity during vehicle operation. The acquired sensor measurements were processed to estimate the actual charging energy requirement and construct a realistic charging demand profile, which was subsequently used as the electrical load input in HOMER Pro. The optimization results identified an economically viable configuration consisting of a 5.49 kW photovoltaic array, a 2.69 kW hybrid inverter, battery energy storage, and utility grid support. The optimized system achieved a Net Present Cost of Rs. 384,080, a Levelized Cost of Energy of Rs. 2.97/kWh, and an annual operating cost of Rs. 13,592. Economic evaluation indicated an Internal Rate of Return of 23%, a Return on Investment of 19%, and a simple payback period of 4.3 years. Furthermore, the proposed system reduced annual carbon dioxide emissions by approximately 1,015 kg, demonstrating the feasibility of developing reliable, cost-effective, and environmentally sustainable rural charging infrastructure for retrofitted electric two-wheelers using experimentally measured battery data.

10:54 Battery-Gated Measurement Validity in Wireless Sensor Deployments: Fault Characterisation, Recovery, and Downstream Consequences

Vasanth Iyer (Grambling State University, USA); Sitharama Iyengar (Florida International University, USA); Vir Phoha (Syracuse University, USA)

Long-running wireless sensor deployments degrade as their batteries deplete, and the resulting measurements can remain within physically plausible ranges while being entirely uninformative. We characterise this failure on the Intel Berkeley Research Lab deployment (54 motes, 2.3 × 10^6 readings): the conventional remedy-filtering by plausible range-leaves the corruption intact in the evaluation window. Three results follow. First, the fault is a discrete rail fault, not a smooth voltage-dependent drift: the converter saturates to a fixed 122.1°C with humidity simultaneously railing negative (383,842 readings). Gating on battery voltage ($V \geq 2.4$ V) reduces the temperature standard deviation from 12.42°C to 3.24°C, removing the corruption rather than clipping it. Second, a voltage-free detector fusing temperature, humidity and light into a Mahalanobis score independently validates the gate (the gate misses only four faults the fused score catches, in 2.2 × 10^6 readings) while showing it over-discards 8.59% of readings; a four-stage cleaner recovers 10.9% more data while improving accuracy 3.6%. Third, the validity protocol determines the outcome of downstream estimation: under range filtering, graph message passing in a Kalman filter appears 13% worse than a graph-free filter at reconstructing unobserved nodes; under voltage gating this reverses to a 27.1 ± 2.9% improvement. We further show global low-rank completion halves the error of graph harmonic extension for removed measurements, and quantify where undetected corruption defeats both. Applying the identical estimator unchanged to human GPS mobility trajectories (taxi, private car; GeoLife) reproduces the graph benefit and surfaces a second, independent protocol-dependence mechanism: taxi's fitted coupling coefficient is the largest observed in either domain, yet invisible in a held-out split containing no co-presence to exercise it.

10:00 to 11:30

S1B: SENSORS FOR PHYSIOLOGICAL MONITORING

Room: 14SCO T3

Chair: Olga Korostynska (OsloMet - Oslo Metropolitan University & ADEPT Research Group, Norway)

10:00 Tracking Heart Rate Dynamics Across Different Art Therapy Tasks

Shokoufeh Moezzi (OsloMet - Oslo Metropolitan University & ADEPT Research Group, Norway); Mimmu Rankanen (Oslo Metropolitan University, Norway); Haroon Khan (OsloMet - Oslo Metropolitan University, Norway); Parisa Gazerani (Oslo Metropolitan University, Norway); Agata Zelechowska (OsloMet - Oslo Metropolitan University, Norway); Olga Korostynska (OsloMet - Oslo Metropolitan University & ADEPT Research Group, Norway)

"Quantifying physiological responses during creative activities is a critical step toward understanding the mechanisms underlying art therapy interventions and developing objective measures of engagement. Artbased activities involve varying cognitive and emotional regulatory process that may elicit distinct physiological responses. This pilot study explores changes in physiological arousal and autonomic responses to emotional expression and regulation by analyzing heart rate dynamics across four art-making tasks: expressive drawing, soothing drawing, expressive clay forming, and soothing clay forming. Electrocardiogram (ECG) data were collected from three participants as pilot during a resting and art-making tasks. Given the heavy motion artifacts introduced by active art-making, an adaptive artifact rejection pipeline was applied to remove artifacts in the ECG recordings. The cleaned signals were then processed using the NeuroKit2 Python library for R-peak detection and heart rate variability (HRV) analysis. At the individual level, two of three participants showed a consistent pattern of heart rate elevation during expressive drawing relative to baseline (Sub_001: 74.0 → 82.9 BPM; Sub_003: 81.4 → 85.3 BPM). Beyond heart rate, additional HRV metrics including standard deviation of normal-to-normal(SDNN) revealed individual-level patterns suggesting possible sensitivity of overall autonomic variability to task intention, particularly in Sub_003, who showed lower SDNN during expressive conditions (38.4 ms; 37.4 ms) compared to soothing conditions (51.9 ms; 42.5 ms). However, these trends were not uniform across participants, with one participant (Sub_002) displaying a distinct autonomic profile throughout all conditions, potentially reflecting emotional carryover from the expressive task. These results describe the physiological trajectories of three individuals only and should not be interpreted as evidence of a general effect. These preliminary observations are consistent with the possibility that different art-making tasks may be associated with distinct autonomic responses and support the feasibility of ECG-based physiological monitoring as a complementary objective measure in art therapy research.

10:18 Design and Functional Validation of a Modular Lab-on-a-Chip Platform for Citrus Disease Diagnostics

I-Huai Lu, Yin-Hao Lai and Joe-Air Jiang (National Taiwan University, Taiwan)

Rapid molecular confirmation is important for managing citrus diseases, but conventional nucleic-acid testing depends on laboratory instruments and trained personnel. This study presents the design and module-level characterization of a continuous-flow microfluidic platform for portable citrus disease analysis. Huanglongbing was selected as a representative disease target for evaluating the fluorescence module. A polydimethylsiloxane-glass chip was designed on a standard 75 mm by 25 mm substrate. Its 3.38 m serpentine channel provides 40 spatial thermal cycles and terminates in an enlarged fluorescence detection region. The platform combines a dual-zone closed-loop heater, a stepper-driven syringe pump, and a sideexcitation optical module using a 475 nm light-emitting diode and a multispectral sensor. At heater set points of 94 and 60 degrees Celsius, the steady-state peak-to-peak fluctuations were 1.400 and 0.500 degrees Celsius, respectively. Pumped liquid mass was linear with motor revolutions, with a coefficient of determination of 0.9991. Fluorescence measurements over the tested reagent dilution range yielded a coefficient of determination of 0.9995. Externally amplified huanglongbing-positive material produced signal increases of 16.7

percent at 525 nm and 21.5 percent at 550 nm relative to the negative background. These results quantitatively characterize the thermal, fluidic, and optical modules and support assay-specific adaptation of the compact lab-on-a-chip platform.

10:36 A Multi-Sensor Sensing and Communication System for Safety and Early Warning of Recreational Boats

Kshitij Satish Gawande, Parth Pravin Shende and Meer Shadman Saeed (Macquarie University, Australia); David Malone (Australia); Subhas Chandra Mukhopadhyay (Macquarie University, Australia)

Small recreational vessels account for most boating fatalities, and many of these incidents develop from conditions that could be detected beforehand, such as deteriorating weather, falling light and rising turbulence. Existing technological solutions are primarily reactive, rely on occupant compliance, or require permanent installation and cellular coverage. This paper presents a portable, IoT-based, early warning system for small recreational vessels. It is an ESP32-based unit that clamps to a boat rail without any vessel modifications. The unit combines temperature, humidity, pressure, ambient light, wind speed, satellite positioning, a nine-axis inertial sensor and a forward obstacle sensor. It delivers graded alerts to the crew's phone through a self-hosted WiFi network, so no cellular service is needed. A preventive detection framework turns these measurements into leading indicators with caution and alert levels. These include a calibrated roll and pitch indicator for capsizing risk, and a dew point derived indicator for fog. Bench calibration of the inertial, atmospheric, light and positioning sensors is reported, and the design limits of the unit are discussed. The work provides a low-cost basis for field trials on small vessels.

10:54 Characterizing Object Grasping Through Tactile Perception on a Quadrupedal Mobile Manipulator

Channa Pradeep Don, Benjamin Brandwood, Christopher Ayoub, Nethum Dhammika Payagalage, Dinuk Ashan Wijesinghe, Sanuth Desitha Wadasinghe, Payam Zarafshan and Karthick Thiyagarajan (Western Sydney University, Australia)

Tactile perception plays a critical role in robotic manipulation by providing direct information about physical interactions between a gripper and the manipulated object. This paper presents a tactile perception framework for characterizing object grasping on a quadrupedal mobile manipulator. A force-sensitive tactile sensor was integrated into the robot gripper and interfaced with a Raspberry Pi-based processing unit to enable real-time acquisition of contact force information during grasping tasks. The proposed framework incorporates sensor calibration, tactile data acquisition, and force-based analysis for evaluating object interactions and grasp performance. Experiments were conducted using objects with diverse material properties, including compliant, fragile, and rigid categories. The results demonstrate that the proposed system can reliably measure contact forces and capture distinct tactile signatures associated with different object types. Analysis of force responses, contact characteristics, and grasp success rates showed that tactile information can effectively characterize object properties and assess grasp stability during manipulation. The developed framework enables robust tactile perception on a quadrupedal mobile manipulator and establishes a practical foundation for future tactile-driven object recognition, adaptive grasp control, and autonomous mobile manipulation in complex real-world environments.

11:12 A Low-Cost Polypyrrole-Functionalized Impedimetric Paper Sensor for pH Detection

Juthamas Hongoeb (Macquarie University, Australia & Mahidol University, Thailand); Subhas Chandra Mukhopadhyay (Macquarie University, Australia); Gora Sengupta (Research Care Pty Ltd, Australia)

Measurement of pH is a fundamental requirement across agriculture, clinical diagnostics, and water management. The conventional devices such as glass electrode-based pH meter and

the alternative colorimetric test strip force a trade-off between accuracy and accessibility. This paper reports a low-cost, disposable, impedimetric pH sensor fabricated by in-situ chemical oxidative polymerization of polypyrrole onto the chromatographic paper, contacted by conductive nylon fabric tape electrodes. The sensing principle exploits the protonation/deprotonation of the polymer backbone which modulates the electrical conductivity of the polymer-coated cellulose network. The optimized paper-based sensor exhibited a two-region linear response with sensitivities of 152.75 Ω/pH across pH 3−8 (R2 = 0.89) and 582.46 Ω/pH across pH 8−14 (R2 = 0.96). The preliminary results establish a proof of concept for a fully disposable, cost-effective paper-based pH sensor, that requires neither a reference electrode nor an indicator reagent at the point of use, enhancing the accessibility to resource-limited area.

11:40 to 13:10

S2A: IOT AND REMOTE SENSING

Room: 14SCO T2

Chair: Vasanth Iyer (Grambling State University, USA)

11:40 KōreroNET: An IoT-Bioacoustics Platform for Automated Ecological Monitoring

Mohammad Amin Barzegar, Akbar Ghobakhlou and Edmund Lai (Auckland University of Technology, New Zealand)

Large-scale bioacoustics monitoring is increasingly used for ecological surveillance, yet continuous audio processing with deep learning models remains impractical on remote, off-grid sensor nodes due to high power consumption and data transfer requirements. This paper presents KōreroNET, a low-power, end-to-end IoT-bioacoustics platform designed to enable autonomous edge-AI monitoring in such environments. Each sensor node integrates a microcontroller-managed Raspberry Pi with an audio recording front-end and employs intervalled recording combined with on-device deep-learning inference to detect vocalising birds and pest species while minimizing energy use. Prototype deployments ran both BirdNET v2.4 and a custom in-house classifier, with BirdNET serving as a benchmark and as a source of labelled real-world noise events to strengthen the system's noise class. By duty-cycling high-power processing to approximately 90 min per day, the platform achieved a daily energy consumption of ~31 Wh, corresponding to an ~82% reduction compared to continuous edge-computer operation. Field trials demonstrate reliable autonomous operation, flexible data transfer, and the practical feasibility of low-power edge-AI bioacoustic monitoring for conservation applications.

11:58 A Low-Cost IIoT Multi-Sensor Platform for Real-Time Electric Motor Fault Detection

Mohammadreza Hojati and Sepideh Yaabdollahi (Macquarie University, Australia); Kundan Singh Shekhawat (Macquarie University, Australia); Meer Shadman Saeed and Subhas Chandra Mukhopadhyay (Macquarie University, Australia)

Unexpected electric motor faults can cause down-time, secondary damage, and increased maintenance cost in industrial systems. This paper presents a low-cost Industrial Internet of Things (IIoT) platform for real-time electric motor condition monitoring and preliminary mechanical fault detection. The proposed system integrates an Arduino Nano 33 IoT, its onboard LSM6DS3 inertial measurement unit, an SHT11 temperature sensor, a shunt-based current sensor, and an A3144 Hall-effect speed sensor. Instead of continuously transmitting raw vibration samples, the embedded node extracts root mean square and crest factor features from three-axis acceleration data over a 20 s monitoring window. Real-time data are published through Message Queuing Telemetry Transport (MQTT) to a local Node-RED dashboard and a Python inference application, while selected measurements are logged to

ThingSpeak through Hypertext Transfer Protocol (HTTP). Experimental data were collected under healthy low-speed, healthy high-speed, loose-screw/soft-foot, and shaft-misalignment conditions. Exploratory analysis showed that vibration-based features provided the clearest class separation, whereas temperature and current were less discriminative under the tested load and speed range. A support vector machine with a radial basis function kernel achieved 95.0% test accuracy, compared with 90.6% for logistic regression. The results demonstrate the feasibility of combining edge feature extraction, lightweight IoT communication, and machine learning for low-cost motor health monitoring.

12:16 Field Trials of IoT Sensors in Agriculture

Gautam Chattopadhyay (Novel Aquatech, Australia); Deep Bhattacharyya (Microsoft, USA); Abhishek Mitra (Qantec Automation, Australia)

Internet of Things (IoT) sensors help farmers monitor conditions across crops, soil, livestock and farm equipment. By collecting data on moisture, temperature, weather and animal activity, these devices can support decisions about irrigation, crop care, livestock health and equipment maintenance. This can improve resource use and help farmers identify problems earlier. However, the benefits depend on reliable sensors, connectivity, proper calibration and useful data analysis. This article reviews key agricultural applications of IoT sensors and considers their advantages and challenges.

12:34 Sensor-Fusion-Enabled Hybrid Micro Wind-Solar Energy Harvesting for Resilient Emergency Power in High-Rise Window Systems

Sandeep Vangapalli (Bits Pilani, India & ARCEDO SYSTEMS PRIVATE LIMITED, India); Aishvaria Gorityala (BITS-Pilani, Hyderabad Campus, India); Radhika Sudha (Birla Institute of Technological Sciences, Pilani, Hyderabad Campus, India)

Reliable emergency power is essential for high-rise buildings, where interruptions in grid supply can affect emergency lighting, communication systems, and evacuation facilities. This paper presents a hybrid wind-solar energy harvesting module integrated into emergency exit windows to provide distributed backup power during grid outages. The proposed system combines a Savonius vertical-axis wind turbine, a vertically mounted building-integrated photovoltaic (BIPV) panel, a battery, and a multi-sensor monitoring unit. A sensor-fusion-based energy management framework is developed using Kalman filtering for windspeed estimation, weighted fusion for photovoltaic power prediction, an LSTM network for short-term energy forecasting, and a Deep Q-Network (DQN) for intelligent load management. Wind resource assessment based on the logarithmic wind profile specified in IS 875 (Part 3) and PV performance obtained from PVsyst simulations were used to evaluate system performance. Results indicate that the proposed module can satisfy a daily emergency load of from approximately the sixth floor onward, achieving a maximum energy coverage of times the required demand and a cumulative surplus of for a representative -storey building. Simulated emergency operation achieved a detection-to-restoration time of . The proposed architecture demonstrates the feasibility of distributed renewable emergency power systems for improving the resilience and sustainability of high-rise buildings.

11:40 to 13:10

S2B: CAPACITIVE AND MAGNETIC SENSING

Room: 14SCO T3

Chair: Robert N Dean (Auburn University, USA & University of Waikato, New Zealand)

11:40 Geometry-Based Response Modelling of an Inline Impedance Sensor for Foreign Object Detection

Niloofar Rezaei, Michael Hayes and Bill Heffernan (University of Canterbury, New Zealand)

Foreign object detection in dairy processing pipelines is important for product safety and consumer trust. However, closed stainless-steel pipes provide limited visibility during operation, making early detection of unwanted material difficult. Impedance-based sensing is

a simple and effective method for this purpose. When a foreign object passes through a conductive liquid, it disturbs the electric field and produces a measurable change in conductance or impedance. This paper presents a geometry-based modelling method for an inline differential impedance sensor designed for foreign object detection in dairy pipelines. Finite element modelling (FEM) in COMSOL Multiphysics was used to study the effect of pipe diameter, object size, insulating gap length, and sensing-region spacing on the sensor response. These geometry variables were written as dimensionless parameters and used to develop a FEM-informed compact model. The results show that the main sensor behaviour can be predicted from the sensor geometry over the tested design range. The model provides a compact way to estimate the sensor response from geometry, which can support sensor design and interpretation without repeating FEM simulations for every case.

11:58 A Lab-on-Valve Platform with a Lab-in-a-Cuvette Concept for Automated Aquaculture Water Analysis

Yin-Hao Lai, Feng-Jie Su and Joe-Air Jiang (National Taiwan University, Taiwan)

Water quality monitoring is crucial for sustainable aquaculture. This study presents a compact, low-cost Labon-Valve platform featuring a novel Lab-in-a-Cuvette concept for automated nitrogen compound analysis. The system achieved highly repeatable liquid sampling (RSD < 2%), excellent calibration linearity (R^2 > 0.99), and successful on-site validation, demonstrating its potential for practical aquaculture water monitoring.

12:16 Solvent-Free Melt Extrusion of PVDF/$BaTiO_3$/TPPC Composite Filaments for Printable Electroactive Applications

Yue Jiang, Mohsen Asadnia and Syed Muzahir Abbas (Macquarie University, Australia)

Solvent-free filament preparation offers a route to PVDF composite feedstocks for additive manufacturing of electroactive structures. This study prepares PVDF/$BaTiO_3$/TPPC filaments by melt extrusion and compares four formulations through thermal, structural, and morphological characterization. Under an α/β approximation, FTIR-derived F(β) estimates were 58.2%, 62.2%, and 64.3% for composite Samples B, C, and D, respectively. Sample D, containing 70:25:5 wt% PVDF/$BaTiO_3$/TPPC with 50 nm $BaTiO_3$, combined the highest estimated F(β) with 35.5% PVDF-normalized crystallinity. XRD supplied qualitative structural support, while SEM-EDS illustrated the ceramic distribution within the extruded composites. Sample D was also printed into a planar coupon using a Bambu Lab P1S, demonstrating its use in filament-based fabrication. Because composition and particle size vary together, the comparisons describe formulation-level differences rather than isolated additive or particle-size effects. The work connects solvent-free filament preparation, phase characterization, and a printing demonstration to guide material selection for subsequent electromechanical evaluation.

12:34 From Optical Observation to Cultivation Intelligence: A Retrieval-Augmented Sensor Reasoning Framework for Autonomous Microalgae Management

Jr-Shian Wu, Yin-Hao Lai, Joe-Air Jiang and Feng-Jie Su (National Taiwan University, Taiwan)

Microalgae cultivation requires continuous monitoring and timely harvest decisions to maximize biomass productivity, yet existing optical sensing systems remain observation-oriented and offer limited support for expert-level decision-making. This paper presents a retrieval-augmented sensor reasoning framework that converts optical observations into actionable cultivation intelligence for autonomous microalgae management. The framework integrates a low-cost RGB optical sensing platform, a vision-guided biomass soft sensor calibrated through cell counting, a continuously evolving cultivation knowledge repository, and a retrieval-augmented reasoning engine that interprets temporal growth dynamics to generate harvest recommendations under uncertain biological conditions. The framework is evaluated on six independent Spirulina cultivation batches with more than 300 manually annotated microscopic images, targeting accurate biomass estimation, reliable harvest-timing

recommendations, and continual knowledge refinement across cultivation cycles. The proposed approach represents a shift from observation-oriented optical sensing toward knowledge-driven sensor intelligence for autonomous biological cultivation systems.

14:00 to 15:12

S3A: THERMAL AND MECHANICAL SENSING

Room: 14SCO T2

Chair: Sabareesh Gr (BITS-Pilani, Hyderabad Campus, India)

14:00 Influence of Joule-Heating-Induced Temperature Distribution on Adjacent Elements

Hiroaki Kikuchi and Shuto Kawasaki (Iwate University, Japan)

Thermal distribution to adjacent elements during anisotropy control of magnetic thin-film elements via Joule heating remains unclear. We investigated thermal crosstalk using two spaced elements, heating only one. Thermal effects, altering magnetic properties, were observed nearby. We confirmed that sufficient distance can mitigate this effect.

14:18 Sensing Through Actuation: Stack-Actuator-Based Continuous Vibration Response Modification in PCB Assemblies

Akashjyoti Barman (Birla Institute of Technology and Science, India); Ikshita Kumar (Birla Institute of Technology and Science Hyderabad Campus, India); Avani Pandit (Birla Institute of Technology and Science Hyderabad campus, India); Sabareesh Gr (BITS-Pilani, Hyderabad Campus, India); Radhika Sudha (Birla Institute of Technological Sciences, Pilani, Hyderabad Campus, India)

Printed circuit board (PCB) assemblies are vulnerable to vibration-induced response amplification when external excitation approaches a structural resonance, a condition that accelerates solder-joint fatigue and component-level degradation. The current research reports an experimental study of stack-actuator-based continuous response modification in a PCB assembly evaluated under three operating cases, i.e., vibration loading with the actuator off, actuator operation without vibration loading, and combined vibration loading with the actuator on. The objective is to determine whether active stack actuation near the PCB can produce a measurable, continuous reduction in vibration severity across the response, independent of any single tracked frequency. Relative to the vibration-only baseline, the combined vibration-actuator case reduces the velocity RMS from 0.015508 to 0.012889, the peak absolute response from 0.318096 to 0.244404, and the peak-topeak response from 0.524436 to 0.443476, reductions of 16.9%, 23.2%, and 15.4%, respectively. The dominant frequency remains fixed at 163.57 Hz across all three cases, confirming that this reduction reflects genuine continuous response modification rather than a shift of the underlying structural mode. Frequency-band energy analysis confirms that the 100-250 Hz band remains dominant in all cases, while higher-frequency energy in the 1000-2000 Hz and 2000-4000 Hz bands decreases under combined actuation. These results demonstrate measurable, continuous, actuator-induced response modification under the tested condition; resonance-tracking-based control and wireless actuator integration are identified as directions for future work building on the current result.

14:36 Development of a Tensile Testing Machine for Electromechanical Characterization of Soft Composite Strain Sensors

Jodel Muñoz and Ronnie Concepcion II (De La Salle University, Philippines)

Recent advances in stretchable and wearable electronics, such as strain sensors, have led to an increased need for instruments for characterizing electromechanical properties of soft and highly compliant materials. While commercial universal testing machines traditionally offer extreme accuracy in obtaining mechanical properties of materials, their high procurement costs and rigid hardware architectures restrict modifications for simultaneous mechanical and electrical characterization. As such, this study presents the design,

fabrication, and validation of a custom tensile testing machine specifically for characterizing electromechanical responses of soft composite strain sensors. The device was fabricated using off-the-shelf and additively manufactured components for a total cost of approximately $270 AUD. The tensile capabilities of the device were validated using additively manufactured specimens of thermoplastic polyurethane and polylactic acid to map distinct material profiles, while resistance measurements were verified using reference resistors across a 1 kΩ to 1 MΩ range. The device was used to obtain the stress-strain and sensitivity plots of a pre-synthesized piezoresistive hydrogel strain sensor. From the eight tested specimens, the sensor was found to have a mean tensile strength of 2.75 ± 0.17 and a mean strain at break of 233.7% ± 58.1%. Meanwhile, the median plot of changes in relative resistance versus changes in strain revealed variable gauge factor values of 0.174 at 0-25% strain, 1.135 at 25-190% strain, and 3.178 at 190% strain to break. Overall, the apparatus demonstrates repeatable, high-fidelity data acquisition, operating as an economically accessible tool for electromechanical characterization of soft composite strain sensors.

14:54 Simultaneous Detection of Multiple Tumor Markers in Whole Blood by an Integrated Centrifugal Microfluidic Electrochemical Sensing Chip

XU Yi, Jianping Liu and Shunbo Li (Chongqing University, China)

Microfluidic chip analytical technology exhibits distinct advantages in the multiplexed detection and highthroughput analysis of tumor markers. In this paper, the sensing strategy based on the sandwich-type square wave voltammetry (SWV) was proposed to simultaneously detect carbohydrate antigen 199 (CA199), carcinoembryonic antigen (CEA), and alpha-fetoprotein (AFP) in whole blood. A centrifugal microfluidic electrochemical sensing chip was designed and fabricated, which integrated several functional units of centrifugal separation, capillary-siphon valve-driven transport and electrochemical detection. According to the sedimentation velocity difference between blood cells and low-abundance tumor markers, the centrifugal separation unit was designed to efficiently separate the tumor markers from blood within 8 min and greatly reduced matrix interference at the source. Based on a capillary siphon valve coupling mechanism, the reagent transport unit was designed to precisely delivery the tumor markers in plasma to the rear electrochemical detection region. This transportation process could be completed within 1 min and overcame the instability issue of conventional passive valve control. In the detection region of the microchip, microelectrode arrays were fabricated via magnetron sputtering. Highly selective Au/AuNPs@Ab1 interfaces were modified on electrode surfaces. The electroactive Au/PTHi@Ab2 nanoprobes were synthesized for signal amplification. A quantitative SWV response was generated upon formation of the Au/AuNPs@Ab1-target-Au/PTHi@Ab2 sandwich immunocomplex mediated by target analytes. The experimental parameters, such as antibody concentration, incubation time and probe concentration, were optimized and selected as 40 μg/mL, 1 h and 0.8 mg/mL, respectively. Subsequently, a novel on-chip SWV detection method for CA199, CEA and AFP in whole blood samples was established with limits of detection (LODs) of 6.34 × 10 -6 U/mL, 2.10 × 10 -5 ng/mL and 1.48 × 10 -5 ng/mL, respectively, which were far below the corresponding clinical reference thresholds of 37 U/mL, 4 ng/mL and 25 ng/mL. The entire "sample in-result out" workflow was completed within 1.5 h. It was illustrated that testing results of clinical samples detected by the centrifugal microfluidic electrochemical sensing chip were consistent with those of the clinical chemiluminescence assay. The sensitivity and accuracy of the established on-chip method were also verified. The detection method based on centrifugal microfluidic chips has demonstrated excellent application characteristics, such as high integration, operation simplification and simultaneous multiplexed target detection and so on.

14:00 to 15:12

S3B: RADAR SENSING

Room: 14SCO T3

Chair: Sérgio Faria (Instituto de Telecomunicações, Portugal)

14:00 Development and Evaluation of a Compact 120 GHz Millimeter-Wave Radar Platform for Short- Range Sensing

Cao Hong Phuc Nguyen (University of Technology Sydney (UTS), Australia); Anh Tuyen Le, Xiaojing Huang and J. Andrew Zhang (University of Technology Sydney, Australia)

This paper presents the development of a compact 120 GHz radar sensing platform supported by a dedicated graphical user interface (GUI) for millimeter-wave (mmWave) experiments. The system combines hardwarelevel radar control with a desktop processing interface that supports waveform configuration, ADC acquisition, binary I/Q transfer, real-time visualization, range-FFT analysis, background-referenced detection, target tracking, and Doppler-based velocity estimation. Experimental results from single-target, two-target, and moving-target measurements validate the platform as a practical tool for radar-board characterization, sensing-algorithm development, and future short-range mmWave sensing applications.

14:18 Development of an Active Reflected Power Canceller for a K-Band Radar

Graham Michael Brooker and Michael R Rubin (University of Sydney, Australia); David Johnson (Mission Systems Pty Ltd, Australia)

This paper describes the implementation of a reflected power canceller (RPC) for a 24 GHz FMCW radar using GT Microwave M2L-80A-5HG digitally controlled IQ vector modulator. It first examines the performance of the vector modulator in a test circuit before including it in a complete radar system. It shows that a gradient descent algorithm run on an Arduino Mega and driven by the DC outputs of the two quadrature mixers in the radar was reasonably effective in cancelling the reflected power in both continuous wave (CW) and frequency modulated continuous wave (FMCW) configurations.

14:36 Foliage Penetration and Structural Sensing of a Mature Plane Tree Using a Scanning 120 GHz FMCW Radar

Raquel Kampel, Graham Michael Brooker, Mitch Bryson, Javier Martinez, David Spray, Tony Cimino, Kelly Lynch and Michael R Rubin (University of Sydney, Australia)

This paper presents the first field-validated characterisation of a scanning 120 GHz Frequency-Modulated Continuous-Wave (FMCW) radar for foliage penetration and volumetric structural sensing, using a mature plane tree canopy as a representative target. A full-range FFT processing pipeline with Cell-Averaging Constant False Alarm Rate (CA-CFAR) detection, recovered 27,195 radar detections. The resulting point cloud resolved the canopy volume, internal branch architecture, and trunk base simultaneously, from a single sidelooking scan position, without requiring synthetic aperture processing. Analysis of the aggregated CFAR point cloud measured a mean two-way in-canopy attenuation rate of 1.50 dB/m (R2 = 0.95), while a per-beam mean attenuation of 4.26 dB/m revealed substantial spatial heterogeneity in canopy density. These results provide the first quantitative field baseline for foliage penetration performance of a 120 GHz FMCW radar in a mature outdoor tree canopy, and demonstrate its capability for volumetric vegetation sensing from a single static observation position.

14:54 Insights into Manually Tuned Reflected Power Cancellers for CW Radar

Michael R Rubin, Mitch Bryson and Graham Michael Brooker (University of Sydney, Australia)

Monostatic continuous-wave (CW) radars are often limited by poor transmitter-to-receiver isolation caused by circulator leakage and strong reflected power, which reduces receiver sensitivity and dynamic range. A common solution is the use of a Reflected Power Canceller (RPC), which samples the transmitted signal, adjusts its amplitude and phase to produce a signal that is 180° out of phase with the unwanted leakage, and reintroduces it into the receiver path to achieve destructive interference. This paper presents the calibration and adjustment procedure for a manually tuned RPC developed for a Ku-band Doppler radar, together with its experimental evaluation. The cancellation performance was characterised using S21 measurements, demonstrating feedthrough suppression of up to 70 dB. The radar calibration was further assessed by sweeping the RPC phase and amplitude settings while

monitoring the receiver RMS output to identify setting combinations that significantly improve receiver sensitivity. Further, the mixer DC output component was analysed and compared to the RPC settings showing how the mixer DC offset can be used to help guide the calibration procedure. These results demonstrate the effectiveness of the RPC in suppressing transmitter leakage and enhancing the performance of monostatic CW radar systems.

15:45 to 17:15

S4A: ONLINE SESSION #1

Room: 14SCO T2

Chair: Daisuke Mizushima (Aichi Institute of Technology, Japan)

15:45 Explainable AI-Enabled Federated Learning for Heterogeneous Healthcare Data over 5G Mobile Edge Computing

Keabineh Kaleb Keba (University of Hyderabad, India); Nagender Kumar Suryadevara (University of Hyderabad, India)

The rapid distribution of healthcare data across medical institutions needs collaborative learning frameworks that allow for decentralized data governance, model interpretability, and low-latency clinical decision support. We propose an explainable federated learning (FL-XAI) architecture over fifth generation (5G) networks and multi-access edge computing (MEC) infrastructure for intelligent healthcare analytics. Unlike the conventional cloud-centric paradigm, the proposed architecture co-locates the model aggregation, inference, and explainability services to the network edge, which significantly decreases the communication overhead and inference delay. The framework enables several machine learning models, such as Random Forest and XGBoost, trained in a federated environment. SHAP and LIME give explanations of model predictions at the population level and instance level, respectively. Incorporating explainability in the MEC layer allows fast and efficient decision support through edge-based processing. We validated this design on real-world endoscopic diagnostic records and the MIMIC-III intensive care dataset. XGBoost achieved classification accuracy scores of 92.31% and 91.85%, for medical images and structural clinical data, respectively, and Random Forest achieved 98.46% on structured clinical data. The framework deployed at the MEC layer achieved a 96.89% reduction in inference latency compared to cloud-based baselines, allowing for reaction times lower than 10 ms for time critical predictions. SHAP and LIME analysis reveal that clinical findings are the driving force of the diagnostic predictions and process attributes are the driving force of the operational decisions. These results demonstrate that edge-native federated learning may simultaneously provide strong predictive performance, inter pretable decision-making, and real-time responsiveness, presenting a feasible strategy toward trustworthy AI in remote healthcare systems. Index Terms-Federated Learning, Explainable Artificial Intelligence, Mobile Edge Computing, 5G Networks, Healthcare Analytics, SHAP, LIME, Edge Intelligence

16:03 Stress-Magnetic Response of API 5L Pipeline Steels for Deepwater Risers Using Metal Magnetic Memory Technique

Gang Tong (CNOOC Research Institute Ltd, China); Jianchun Fan (China University of Petroleum - Beijing, China); Renjun Xie (CNOOC Research Institute Ltd, China); Wenlan Chen (China University of Petroleum (Beijing), China); Yingjun Wang (CNOOC Research Institute Ltd, China)

This study examines the stress-magnetic response of API 5L X80, X65, and X60 pipeline steels, focusing on deepwater risers, using the metal magnetic memory (MMM) method. Experimental results highlight distinct differences between loading and unloading phases. During unloading, a consistent demagnetization pattern emerges, linked to material anisotropy and residual stress, contrasting with the loading phase. Higher coercivity steels show greater sensitivity to these changes. Numerical simulations with the Jiles-Atherton model confirm that higher saturation magnetization enhances the stress-magnetic effect, with minimal impact from geomagnetic fluctuations. These findings support MMM as a reliable non-destructive testing method for assessing stress states in deepwater riser steels.

16:21 Long-Term in-Situ Multi-Sensor Observation of Cold Seep Environments: From Lander-Based Campaigns to Networked Observatories

Zengfeng Du, Xiong Zhang, Xuhao Sun, Chao Lian, Zhendong Luan and Xin Zhang (Institute of Oceanology, Chinese Academy of Sciences, China)

Understanding the temporal dynamics and regulatory mechanisms of cold seep ecosystems requires continuous, long-term in-situ observation data; however, the episodic nature of seep venting, the spatial heterogeneity of chemosynthetic communities, and the technical challenges of sustained deep-sea monitoring have constrained progress in this field. This paper presents integrated findings from a multi-year in-situ observation campaign at the Formosa Ridge cold seep (Site F) in the South China Sea, utilizing a selfdeveloped long-term ocean observation platform (LOOP and Mini-LOOP). The LOOP, featuring a novel controllable launching and recovery mode with online real-time control and offline stand-alone operation capabilities, was deployed for 375 days (2016) and 414 days (2018), revealing strong spatial heterogeneity of salinity and dissolved oxygen at both horizontal and vertical scales near cold seep vents-a likely driving factor for the uneven spatial distribution of chemosynthetic communities. Fourteen-day continuous in-situ Raman spectroscopic monitoring deployed by Mini-LOOP captured two active periods of gas hydrate formation interspersed with decomposition phases during quiescent intervals. These findings support a gas hydrate capacitor hypothesis, wherein shallow gas hydrates in sediments buffer methane supply and confer stability to chemosynthetic ecosystems. Acoustic Doppler current profiler (ADCP) observations from both LOOP and Mini-LOOP deployments further demonstrated that methane emission intensity is closely correlated with bottom pressure fluctuations controlled by tidal cycles, suggesting that hydrostatic pressure changes modulate gas release through cyclic hydraulic fracturing. What's more, a newly developed cold seep observation node has been launched at Site F and linked into the Deepsea Network China (DNC) in July 2026. The cold seep observation node will enable real-time, multi-source data fusion, providing unprecedented opportunities to elucidate the coupling mechanisms between physicochemical environmental fields and biological communities. The transition from autonomous landers to networked observatory nodes represents a paradigm shift in deep-sea sensing technology, moving from episodic snapshot observations toward continuous, ecosystem-level monitoring of cold seep environments.

16:39 Measurement-Informed Digital-Twin Control for Grapevine Irrigation and Fertilization Across Iberian Climates

Stefan Postolache (Iscte-IUL and Instituto de Telecomunicacoes, Portugal); Pedro Sebastião (ISCTE-IUL, Portugal); Vitor Viegas (Escola Naval Portugal & CINAV, Portugal)

Digital twins that assimilate sensor data into crop models are expected to improve irrigation and fertilization decisions, but the interaction between sensor-based state cor- rection and learned control policies is rarely tested. This paper couples the WOrld FOod STudies (WOFOST) grapevine model, via WOFOSTGym, with deep reinforcement learning policies and a digital twin that assimilates soil-moisture and leaf-area measurements, in an observing system simulation experiment across Iberian climates. Policies were trained with a reward netting yield against calibrated input costs and compared with validation-tuned fixed schedules, using peak rather than season- end fruit weight, which post-veraison decay distorts. Assimilating daily soil moisture reduced the twin's forecast error by 65- 73% in every setting. Better estimates did not by themselves improve decisions. A Deep Q-Network (DQN) policy trained only on the nominal soil reduced its inputs when shown the drier corrected state, lowering field yield by 30%. Training over randomized field capacity produced a policy that outperformed a globally tuned schedule at the training sites, also in untouched years, and turned assimilation into a yield gain under mild model error. It showed no significant difference from a site- tuned schedule or at unseen locations. Under extreme soil-model mismatch, assimilating soil moisture while keeping the incorrect field capacity still degraded its decisions. Giving the twin the true field capacity eliminated these losses, which motivates joint state-parameter estimation. Measurement-informed control thus depends not only on accurate state estimation but also on how the policy responds to corrected states and whether they are consistent with the model parameters.

16:57 Adaptive Quantum Sensing and Resource Optimization for Magnetocardiography Data on a 5G MEC Server

Sandeep Madanu and Nagender Kumar Suryadevara (University of Hyderabad, India); Keabineh Kaleb Keba (University of Hyderabad, India)

An optically pumped magnetometer (OPM) is one of the promising options for non-invasive approach towards analyzing magnetocardiography(MCG) data. In the scenario of deploying high density of OPM sensor networks, severe bottlenecks in the process of data acquisition and communication exist. In this paper, a quality and network aware adaptive allocation methodology was presented. The framework considers the Signal Quality Index and extract the index (SQI) from 8 MCG channels to select the optimized subset and then modulate quantum resources. we validate the end-to-end framework as static and adaptive configuration, based on empirical OPM-MCG data of Kiel Cardio Database (91 five second windows across seven subjects) on a 5G mobile edge computing (MEC) testbed. The adaptive mechanism reduced the transmission to half the number of times. The shot workload of qubit was reduced by 36.33% whereas a decrease in average circuit depth and two qubit gates go up by 15.07% and 21.33%, respectively. The adaptive throughput was 33.30% lower than the fixed baseline.

17:15 Implementation of IoT (Internet of Things) on a Mini SCADA-Based Room Monitoring and Physical Security System

Dicky Ardiansyah Pramana Putra and Unan Y Oktiawati (Universitas Gadjah Mada, Indonesia); Irving V Paputungan (Universitas Islam Indonesia, Indonesia & Universiti Teknologi Petronas, Malaysia)

Technological developments, especially in the industrial sector, are increasingly encouraging the utilization of the IoT as a solution in monitoring and security. One of the potential implementations of IoT is the monitoring system and physical security of the room, especially in environmental and security aspects. This research aims to develop a Mini SCADA system. SCADA stands for Supervisory Control and Data Acquisition which is defined as a computer-based industrial control system that performs control for industry, infrastructure, and facility processes. The Mini SCADA that will be studied functions to monitor room conditions, such as hazardous gas levels, temperature, humidity, and security systems. This system is designed using ESP8266 as a microcontroller, which sends sensor data using HTTP protocol to Google Sheets and Influxdb Cloud, then visualized through Grafana Cloud and a combination of telegram bots as interactive controls. The research method of this system includes hardware design, software design, and system testing and finalization until it functions as needed. The expected result of this research is the creation of an IoTbased room monitoring and physical security system that can improve user comfort and safety, as well as provide a new understanding of the application of SCADA on a small scale.

15:45 to 17:15

S4B: SENSING RELATED TO MOTORS, ROBOTS AND DRONES

Room: 14SCO T3

Chair: Karthick Thiyagarajan (Western Sydney University, Australia)

15:45 Data-Driven PI Controller Tuning for Three Dimensional Motion Control Systems

Shun Fukuda (Utsunomiya University, Japan); Taketo Azuma and Hiroshi Sakuma (Utsunomiya University, Japan)

Data-driven PI controller tuning problems are discussed for three-dimensional motion control systems with three rotating permanent magnetics. Using input-output data of the three-dimensional motion control systems, PI gains are adjusted based on Fictitious Reference Iterative Tuning(FRIT) methods. Numerical study demonstrates the efficacy of the considered PI controller tuning approaches.

16:03 Robodeck: Multimodal Optimised Scene Synthesis for Robotic Simulators

Isaac Velayo (University of Technology Sydney, Australia); Sarath Kodagoda (University of Technology, Sydney, Australia); Sangmim Song, Vinu Vihan Maddumage and Amal Gunatilake (University of Technology Sydney, Australia)

The increasing use of intelligent robotic systems has created a growing demand for realistic, scalable, and diverse simulation environments. However, manually designing functional 3D environments remains timeconsuming and limits the scalability of robotic simulation. Recent advances in large language models (LLMs) enable automated scene generation from natural language descriptions, but generated environments often contain spatial inconsistencies and configurations unsuitable for robotic applications. This thesis presents Robodeck, a framework for generating and refining simulator-ready 3D environments by integrating LLMdriven scene generation, structured scene representations, and multimodal verification and optimisation. Building upon the Holodeck framework, Robodeck introduces a two-stage optimisation pipeline that uses GPT-4o Vision to evaluate generated scenes, identify spatial and semantic violations, and apply targeted corrective operations including object removal, rotation, and repositioning. The framework is evaluated across multiple indoor room types using quantitative and qualitative analysis. Results demonstrate that the optimisation pipeline consistently improves overall scene quality, with mean score improvements observed across all evaluated room categories, while correcting common errors including incorrect object orientations, misplaced objects, and semantically inconsistent arrangements. Failure analysis further reveals that optimisation effectiveness is influenced by the complexity of spatial relationships, with challenges emerging in scenarios requiring global navigability reasoning or coordinated optimisation of object groups. These findings demonstrate the potential of multimodal verification as an effective approach for refining automatically generated environments, reducing manual scene editing requirements and improving the reliability of simulator-ready environments for embodied AI and robotic testing.

16:21 Improving Wireless Anchors Synchronization in UWB RTLS

Bruno F. J. Inácio (University of Leiria, Portugal); Telmo R. Fernandes (University of Leiria, Portugal & Instituto de Telecomunicações, Portugal); Sérgio M. M. Faria (Instituto de Telecomunicacoes & Instituto Politecnico de Leiria, Portugal)

The overall performance of a spatial information sensing system is strongly contingent upon the precision of anchor synchronization in Ultra-Wideband (UWB)-based Real-Time Location Systems (RTLS). For example, in logistics warehouse systems, synchronization accuracy exerts a direct influence on positioning precision, system reliability, scalability, and overall deployment cost. In Time Difference of Arrival (TDoA)-based localization, timing offsets on the order of nanoseconds between anchor nodes can induce substantial spatial localization errors, potentially impairing the correct identification and tracking of assets, vehicles, and personnel in warehouse environments. The use of wireless synchronization mechanisms reduces reliance on wired timing infrastructure, thereby facilitating more rapid installation, simplifying system expansion, lowering maintenance expenditures, and improving adaptability to frequently changing warehouse layouts. Nevertheless, the realization of wireless synchronization schemes is generally more susceptible to timing inaccuracies. Consequently, achieving high positioning accuracy in such environments poses substantial challenges, particularly with respect to time synchronization and anchor localization. To address these limitations, this work introduces a wireless synchronization framework for TDoA-based RTLS, which employs a dedicated Reference Node (RN) to enable dynamic clock-skew compensation. Experimental evaluations indicate that the proposed configuration attains a positioning accuracy of 30 cm with a standard deviation of 15 cm.

16:39 Tactile Terrain Perception for Quadrupedal Robots Using Force-Sensitive Resistors

Sanuth Desitha Wadasinghe, Benjamin Brandwood, Christopher Ayoub, Nethum Dhammika Payagalage, Dinuk Ashan Wijesinghe, Channa Pradeep Don, Payam Zarafshan and Karthick Thiyagarajan (Western Sydney University, Australia)

Legged robots primarily rely on vision and LiDAR for terrain perception; however, these sensing modalities are susceptible to environmental conditions and cannot directly measure terrain physical properties. This paper presents a low-cost tactile sensing framework for real-time terrain classification in a quadrupedal robot without modifying the commercial robot platform. The system integrates four force-sensitive resistor (FSR) sensors with an external sensing module comprising an analog-to-digital converter, a microcontroller, and a Raspberry Pi running a ROS 2-based processing framework. A dataset of 7,160 segmented foot-contact events was collected across three terrain types: carpet, concrete, and grass. Twelve time and force-domain features were extracted and used to train a Random Forest classifier for terrain recognition. Experimental results achieved balanced accuracies of 85.6% under ten-fold cross-validation and 75.7% under leave-onesession-out validation, demonstrating strong classification performance and generalization to previously unseen environments. Feature importance analysis showed that contact timing and force-profile characteristics are more informative than peak force alone. The framework also maintained reliable performance under partial sensor failure, highlighting its robustness. The proposed approach provides a practical complementary sensing modality to vision and LiDAR, enhancing terrain perception and supporting more adaptive locomotion in autonomous quadrupedal robots operating in complex environments.

16:57 Development and Comparative Evaluation of a 1:10-Scale Autonomous Driving Platform Using Adaptive Centroid-Based and CNN-Based Lane Following

Meer Shadman Saeed and Nicholas Cavanaugh (Macquarie University, Australia); Alice James (Macquarie University, NSW, Australia); Avishkar Seth and Subhas Chandra Mukhopadhyay (Macquarie University, Australia)

This paper presents the development and comparative evaluation of a 1:10-scale autonomous driving platform based on a Tamiya TT-02 chassis. The platform was experimentally characterised to establish its longitudinal velocity and steering responses. Two lane-following approaches were implemented: an adaptive multi-scanline centroid-based algorithm incorporating lane-width estimation and feedback control, and a convolutional neural network (CNN) trained through behavioural cloning to predict steering commands from binary lane images. Both approaches were evaluated on the same physical track at four longitudinal PWM commands, corresponding to estimated velocities of 0.48–0.89 m/s, using lap completion time and lateral tracking deviation as performance metrics. Results showed that the centroid-based approach generally achieved shorter lap times, while the CNN exhibited lower trial-to-trial variability, but a systematic leftward bias potentially associated with its training data. Although trained at approximately 0.48 m/s, the CNN completed laps at PWM commands corresponding to estimated velocities up to 0.89 m/s on the same track. These results illustrate trade-offs between lap completion time, repeatability, and lane-centring accuracy, while the limited trial count warrants cautious interpretation.

TUESDAY, DECEMBER 8TH

9:00 to 10:30

S5: KEYNOTE #1 AND #2

Room: 14SCO T2

Chair: Subhas Chandra Mukhopadhyay (Macquarie University, Australia)

Keynote Speaker: Transforming Eye Care with Artificial Intelligence
Associate Professor Maitreyee Roy, University of New South Wales, Australia

Industry Speaker: ParkPilot: A Smart and Environment-friendly Vehicle Parking
Dr. Arindam Pal, CEO and Director, TechSoftX Corporation, Sydney, Australia

11:00 to 12:30

S6: KEYNOTE #3 AND #4

Room: 14SCO T2

Chair: Akbar Ghobakhlou (Auckland University of Technology, New Zealand)

Keynote Speaker: Smart Sensing and AI for Healthcare
Professor Wei Chen, University of Sydney, Australia

Invited Speaker: Design and Control of Microelectromechanical Systems for Scanning Probe Microscopy
Dr Michael Ruppert, University of Technology Sydney, Australia

13:30 to 15:00

S7A: WEARABLE SENSORS AND ACTIVITY MONITORING

Room: 14SCO T2

Chair: Wei Chen (University of Sydney, Australia)

13:30 EEG Network Analysis of Working Memory Neural Dynamics Under Varying Cognitive Load

Huy Xuan Dao (Hanoi University of Science and Technology, Vietnam); Minh Tran (Vietnam); Kmy N. Quach (Hanoi University of Science and Technology, Vietnam); Huyen T.n. Nguyen (Posts and Telecommunications Institute of Technology, Vietnam); Thuy T. Pham and Stuart W. Perry (University of Technology Sydney, Australia)

Working memory (WM) has a limited capacity and depends on distributed brain networks, mainly frontoparietal regions. These networks change with cognitive load. We modeled WM activity as a network rather than as separate active regions, and investigated how load alters inter-regional interactions. We recorded 19channel electroencephalography (EEG) from 53 healthy young adults during a visual n-back task with two loads: a low-load 0-back and a high-load 2-back. We estimated functional connectivity in the theta, and alpha bands using a sliding-window method that combined Welch cross-spectral coupling with eigenvectorcentrality correlation. We then described load-related change as a difference network (2-back minus 0-back) at the edge and node levels. Behaviourally, reaction time was longer under high load, while target accuracy remained uniformly high across both loads. This pattern indicates a load effect on processing speed rather than on accuracy. In the network, alpha connectivity fell over fronto-parietal sites and rose over central sites; theta connectivity rose over fronto-parietal sites (centred on Cz and C4) and fell over the left hemisphere. These

patterns match known roles of alpha (inhibition) and theta (WM coordination). Because the method uses low-cost, non-invasive EEG, it may serve as an accessible tool for studying WM networks, once validated statistically.

13:48 The OrthoMouse: A Sensor-Integrated Orthosis for Dual-Mode PC Control and Wear Monitoring

Adam Kristiansen (ADEPT Research Group, Oslo Metropolitan University OsloMet, Norway); Wiktoria Stefania Trepka, Ida Cecilie Brænde Svendsen and Morten Ødegård (ADEPT Research Group, Oslo Metropolitan University, Norway); Anne-Marthe Sanders (Sunnaas Rehabilitation Hospital, Norway); Olga Korostynska (OsloMet - Oslo Metropolitan University & ADEPT Research Group, Norway)

Effective rehabilitative interventions are critical for individuals recovering from major trauma, and these serve as a primary determinant of the successful neuromuscular function outcomes, in addition to pain mitigation, psychosocial well-being and health-related quality of life. This paper presents novel tested prototype of a highly personalised, 3D-printed wrist orthosis with integrated electronics. The orthosis combines therapeutic support with computer-interaction capabilities to improve user engagement. The prototype integrates tactile input buttons, accelerometer-based cursor control, and sensor-based wear monitoring. Mouse-function testing showed accuracy values of 75-100%, while efficiency remained lower than a standard mouse at 17- 27%. A companion smartphone application was developed to visualise estimated orthosis use from sensorfusion data, including accelerometer values, temperature and humidity.

14:06 Enhancing Residential Aged Care Through AI-Based Fall Detection and Activity Monitoring Systems

Martin Mapley, Thi Phuoc Van Nguyen and Ronaldo Santana (Homeguardian.ai, Australia)

Falls are a leading cause of injury and loss of independence among older adults in residential aged care. Traditional detection methods, including wearable devices and motion sensors, often suffer from compliance issues, limited coverage, and tend to be reactive rather than proactive. This paper presents HomeGuardian, an AI-driven, edge-deployed monitoring system that provides continuous, non-contact fall detection and activity monitoring with pre-incident alerting. The system integrates several AI models including detectors, classifiers, pose estimator, and two statistical decision models to accurately identify falls and track resident activities in real time. All models are quantized and optimized for execution on a Neural Processing Unit (NPU), achieving frame rates of up to 7 fps while preserving privacy by performing all inference locally. Field deployments in residential aged care facilities demonstrate high detection accuracy, rapid alerting, and strong staff acceptance, enabling both reactive fall response and proactive fall prevention through longitudinal activity monitoring. HomeGuardian illustrates the potential of AI-based edge monitoring to enhance resident safety, support clinical decision-making, and improve quality of care in modern aged care environments.

14:24 Development of a Wireless Bioelectronic System for Continuous Sweat Biomarker Monitoring Outside Laboratory Settings

Jerome Rajendran, Shingirirai Chakoma and Rahim Esfandyarpour (University of California Irvine, USA)

Continuous cortisol monitoring can provide valuable insight into stress dynamics and disease progression; however, conventional blood- and saliva-based measurements provide only intermittent snapshots and are impractical for long-term monitoring during daily activities. Most wearable biochemical sensing platforms rely on on-skin batteries, increasing device size and cause biohazards. Recent battery-free wireless-based sensors typically depend on smartphones for wireless power delivery and data acquisition. Consequently, these systems require repeated user intervention, limiting their operation to on-demand measurements rather than continuous and long-term monitoring. Here, we present the development of a wearable biochemical monitoring system comprising a battery-free flexible cortisol sensing

patch and a wrist-worn reader for continuous cortisol monitoring. The sensing patch integrates wireless iontophoresis, microfluidic sweat collection, and an electrochemical sensing interface with a synthetic molecular recognition layer, while the wrist-worn reader enables autonomous wireless interrogation, real-time processing, and local data logging. The system was validated through on-body stress measurements against ELISA and subsequently demonstrated continuous 12-hour cortisol monitoring during daily activities, establishing a practical platform for autonomous long-term biochemical stress monitoring.

14:42 Development and Evaluation of a Prussian Blue-Plated Uric Acid Biosensor

Kazuya Suzuki (Tokyo University of Technology, Japan); Kohji Mitsubayashi (Institute of Science Tokyo, Japan)

Chronic wounds pose a major clinical challenge due to prolonged healing processes caused by underlying diseases and impaired local blood flow. Early detection of healing stagnation, infection, and symptom exacerbation through real-time biochemical monitoring of wound exudate is crucial for effective treatment. Uric acid (UA) in wound exudate has emerged as a promising biomarker reflecting tissue oxidative stress and inflammation levels. In this study, a high-sensitivity electrochemical uric acid biosensor modified with a Prussian Blue (PB) thin film via electroplating was developed for non-invasive wound monitoring applications. Carbon working electrodes and silver/silver chloride (Ag/AgCl) reference electrodes were fabricated on a flexible polyethylene terephthalate (PET) substrate using screen-printing techniques. A uniform PB thin film was electrodeposited onto the carbon electrode surface via cyclic voltammetry to serve as an electrocatalyst for hydrogen peroxide (H2O2) reduction. Subsequently, uricase and chitosan were immobilized on the PBmodified electrode to construct the UA biosensor. The fabricated PB-plated UA biosensor exhibited rapid and stable amperometric output responses to varying uric acid concentrations. The sensor demonstrated high linearity over a wide concentration range from 500 nM to 100 µM with an excellent coefficient of determination (R2 = 0.997). Upon addition of 50 µM uric acid, the response current of the PB-plated biosensor reached 119 nA, representing a remarkable 158.7% increase (approximately 2.59-fold amplification) compared to that of the PB-unmodified sensor (46 nA). This significant current enhancement is attributed to the superior electrocatalytic activity of the PB layer, which effectively mediated electron transfer during H2O2 reduction at the electrode interface. The quantifiable range of the sensor (500 nM to 100 µM) successfully covers concentrations below typical uric acid levels found in actual wound exudate (220 to 750 µM), making it suitable for sample-diluted real-specimen analysis. These results demonstrate that PB electroplating effectively enhances sensor sensitivity while preserving high linearity, offering a promising foundational technology for future wearable wound monitoring devices and smart dressings.

13:30 to 15:00

S7B: IMAGE SENSING

Room: 14SCO T3

Chair: Michael Ruppert (UTS Sydney, Australia)

13:30 Doppelganger-1500: A Benchmark for Image Matching Under Perceptual Aliasing and Large Rotations

Hoàng Quách (University Technology Sydney, Australia)

Robust image matching remains a fundamental challenge in visual localization and 3D reconstruction, particularly under perceptual aliasing and extreme viewpoint changes. While recent learning-based methods have achieved strong performance on standard benchmarks, these evaluations often overlook failure modes arising from visually similar but geometrically distinct scenes (doppelgangers) and large relative rotations. In this paper, we introduce Doppelganger-1500, a benchmark dataset specifically designed to evaluate image matching under the combined challenges of perceptual aliasing and large rotations. The dataset consists of approximately 1,500 carefully curated image pairs, selected from public datasets using a structured pipeline that enforces visual similarity along with significant viewpoint

variation. We further propose an evaluation protocol based on relative rotation error, which serves as a practical proxy for geometric consistency in downstream structure-from-motion pipelines. We conduct a comprehensive evaluation of state-of-the-art matchers, including LightGlue, Adalam, and VGGT. Experimental results show that all methods suffer substantial performance degradation under these conditions, highlighting a critical gap in current evaluation benchmarks. Our findings suggest that existing matching approaches remain heavily reliant on appearance cues and lack robustness to ambiguity and extreme viewpoint changes. We believe this benchmark provides a valuable testbed for developing next-generation matching methods that explicitly account for perceptual ambiguity. The source code and benchmark evaluation framework are publicly available at https://github.com/quachconghoang/doppelgangers-match

13:48 Mutual Information-Based Selection of Interpretable Kinematic Features for Isolated Vietnamese Sign Language

Huy Xuan Dao and Kmy N. Quach (Hanoi University of Science and Technology, Vietnam); Thuy T. Pham and Stuart W. Perry (University of Technology Sydney, Australia)

Identifying which interpretable kinematic descriptors carry sign identity is a prerequisite for data-efficient and explainable skeleton-based Sign Language Recognition (SLR). This pilot study on isolated Vietnamese Sign Language (VSL) couples a 64-dimensional, scale-normalized spatiotemporal descriptor, computed from AlphaPose HALPE-136 keypoints, with mutual information (MI) ranking and a validation protocol designed for very small samples: exact label-permutation tests with family-wise error control, leave-out stability analysis, and nested cross-validation against six feature-selection baselines. For five compound signs sharing the lexeme BUN versus five dissimilar signs, the horizontal orientation of the non-dominant (left) index finger during the first quarter of the sign carried 0.53-0.56 nats (76-81% of the label entropy) and was the only descriptor that remained significant after correction for 64 tests ($p_{FWER} \leq 0.032$). As hypothesized, information concentrated in the early segments ($p \leq 0.024$), and five MI-selected descriptors reached 0.73- 0.79 leave-pair-out accuracy versus 0.65 with all 64. The ranking was reproduced with an independent pose estimator (Spearman rho = 0.90) and was not explained by signer identity. Against seven visually similar signs produced by the same signer, no single descriptor survived correction and univariate MI selection fell to chance, whereas multivariate models remained above chance, indicating that fine lexical contrasts are encoded jointly. The results support MI as an interpretable screening tool for SLR features and delineate its limits.

14:06 Minimal Proprioceptive Sensing System for Non-Anthropomorphic Bipedal Platform Stabilization on Uneven Terrain

Vince Andrei S. Dela Paz, Marian Lubag, Christian Rae Cacayurin, Jonathan Jr O. Marcelino, Perrie Lance Perocho, Mark Angelo Lubreza, Alliah Irish De Guzman and Ronnie Concepcion II (De La Salle University, Philippines)

Agricultural field robots have been significantly implemented in the industry mainly due to their ability to enhance farm efficiency and productivity. However, due to the unstructured and unpredictable nature present in the agricultural environment, robotic platforms are prone to experience body tilt which can affect the robot platform stability, sensor alignment and sensing consistency. Existing stabilization approaches often rely on multiple internal sensors and complex control architectures, which increases hardware complexity and computational demand. This study aimed to develop and evaluate a simple proprioceptive feedback approach through the use of a single ADXL345 accelerometer on a tilt-compensating leg platform. A proportional controller was implemented to efficiently scale the corrective actuator response based on the magnitude of the tilt error. Different terrains simulations, including flat, step, and slope, were done to test the platform. Results showed that the system achieved the lowest tilt estimation error on flat terrain with an MAE of 0.175° and RMSE of 0.215°, while all non-flat conditions produced residual tilt errors below 1° after correction. The system achieved mean tilt reduction percentages of 90.46% for the right step, 92.80% for the left step, 96.46% for the right slope, and 96.21% for the left slope, with longer response times observed under slope conditions due to larger initial tilt angles. These findings suggest that a single low-cost

accelerometer can provide usable internal tilt feedback for low-speed self-leveling applications, although further improvements in mechanical stability, sensor filtering, and field testing are needed to enhance performance under actual agricultural terrain conditions.

14:42 Temperature Conditioned Spatial Agreement Between MODIS and VIIRS Active-Fire Detections During the 2023 Barkly Fire Season

Shiva P (Curtin University of Technology, Australia); Dheeraj Kumar (Indian Institute of Technology (IIT) ISM Dhanbad, India); Apurna Ghosh (Curtin University, Australia)

Active fire detection is a common application of MODIS and VIIRS across the large Australian landscape, albeit with varying spatial resolutions, sampling geometries, and active fire detection capabilities. This study aimed to assess the spatial consistency of the MODIS and VIIRS active fire products over the Barkly region of northern Australia during September-November 2023. To assess if joint detection changed across the thermal landscape, Landsat daytime land-surface temperature (LST) was analyzed. The MODIS and VIIRS observations were merged into 4,329 grid cells common to both sensors, resulting in the categories: Both, MODIS only, VIIRS only, and Neither. The MODIS-VIIRS Jaccard agreement was 0.896 for September, 0.867 for October, and 0.709 for November. The percentage of cells detected jointly increased from 0.9% below 35 °C to 91.5% in the 45-50 °C class in September. In October, the pattern was non-monotonic, and in November, it was weak. The overlap between the two sets of cells detected by both methods was high, with 98.3%, 96.7%, and 92.0% of cells detected in September, October, and November, respectively. The results indicate that daytime LST was useful for assessing MODIS-VIIRS agreement in the early fire stage but not for serving as a stable, independent indicator of active fire throughout the season.

15:30 to 17:18

S8A: BIO-SENSING

Room: 14SCO T2

Chair: Shunbo Li (Chongqing University, China)

15:30 Interpretable Modeling of Electrode Geometry-Performance Relationships in Chemiresistive Gas Sensors

Yue Liu, Fengchun Tian and Yuzhu Nie (School of Microelectronics and Communication Engineering, Chongqing University, Chongqing, China); Ran Liu (College of Computer Science, Chongqing University, Chongqing, China); Haijing Liu (School of Microelectronics and Communication Engineering, Chongqing University, Chongqing, China); Zhiyuan Wu (School of Information Engineering, Jiangxi University of Water Resources and Electric Power, Jiangxi, China)

The development of high-performance gas sensors relies on the synthesis of novel sensitive materials, while electrodes, acting as signal transducers, play an equally important role in sensor performance. Gas sensor electrode design often relies on empirical trial-and-error approaches, providing limited understanding of the interactions among electrode geometric parameters. In this work, we propose a data-driven framework that integrates high-throughput experiments and symbolic regression to establish the relationship between electrode geometry and gas sensing performance. A flexible sensor array containing hundreds of electrode configurations was developed, and a bioinspired structure was introduced to ensure consistent testing conditions across sensing units. The Sparse Identification of Nonlinear Dynamics (SINDy) was used to extract interpretable equations, describing the nonlinear relationships between electrode geometry (gap, width, and number of pairs) and sensing performance. This work provides a framework for evaluating gas sensing electrodes and offers a methodology for future modeling and analysis of gas sensors.

15:48 Discrimination of Low-Molecular-Weight Aldehydes Using a Multi-Species Odorant Receptor Panel for Biosensing Applications

Haruto Kudo (Tokyo University of Agriculture and Technology, Japan); Reina Kanemaki (Tokyo University of Agriculture and Technology, Japan); Yosuke Fukutani (Tokyo University of Agriculture and Technology, Japan)

Living organisms discriminate between a vast diversity of odors through combinatorial response patterns of odorant receptors (ORs). In recent years, ORs have attracted considerable attention as promising elements for next-generation odor biosensors. Low-molecular-weight aldehydes, such as acetaldehyde, are not only pungent malodorous compounds but also pose risks to human health and the environment due to their toxicity. However, human ORs responsive to short-chain aldehydes, such as acetaldehyde and propanal, remain unidentified. In this study, we aimed to identify previously uncharacterized ORs responsive to lowmolecular-weight aldehydes and construct a multi-receptor "OR panel" by integrating these receptors with known aldehyde-responsive ORs, toward the development of a biosensor capable of discriminating aldehydes based on receptor response patterns. Using a gas-phase stimulation assay, we screened approximately 560 human ORs and successfully identified OR6B1 as a novel acetaldehyde-responsive receptor. Furthermore, ortholog analysis across multiple species revealed functional diversity among homologous ORs, with some orthologs exhibiting enhanced sensitivity, improved structural stability, or selective responsiveness to longerchain aldehydes compared with their human counterparts. In addition, multivariate statistical analyses, including principal component analysis (PCA) based on the responses of human, canine, and murine ORs, demonstrated the clear clustering of different aldehydes. These results indicate that the constructed OR panel enables the reliable discrimination of structurally similar aldehydes with high resolution. Collectively, our findings suggest that a multi-species OR panel represents a highly effective strategy for next-generation odor-sensing systems, achieving both high sensitivity and discriminative capability. With further optimization, this approach holds strong potential for practical applications, including the detection of food spoilage, disease-related volatile biomarkers, and environmental malodors.

16:06 Bio-Fluorometric Gas Imaging of Transcutaneous Volatiles Derived from Blood Vessels

Kohji Mitsubayashi (Institute of Science Tokyo, Japan); Zhang Geng (Tokyo Medical and Dental University, Japan); Kenta Iitani (Institute of Science Tokyo, Japan); Kenta Ichikawa (Tokyo Medical and Dental University, Japan); Yoshikazu Nakajima (Institute of Science Tokyo, Japan)

Volatile organic compounds (VOCs) can be used to evaluate human biochemical conditions. Especially, transdermal VOCs are promising for real-time monitoring. While transdermal VOCs are thought to be affected by local skin conditions, research tools to study their effects are lacking. Here, we developed an enzymebased fluorometric image-sensing system for transdermal ethanol in a 90 mm by 90 mm region of interest. This system allowed the measurement of 10 ppb to 100 ppm of gaseous ethanol with high selectivity. By using the system, spatiotemporal imaging of transdermal ethanol emitted from the palm and wrist after drinking alcoholic beverages was possible.

16:24 Portable VOC Sensing Device for Real-Time Hospital Indoor Air Quality Surveillance

Edward Sagara Karundeng, Haoxuan Xia, Qiyu Fu, Yi Zhong and Sumedha N. Prabhu (The Chinese University of Hong Kong, Shenzhen, China)

Volatile organic compounds (VOCs) are important indoor air contaminants in healthcare facilities because they may originate from disinfectants, sterilants, cleaning agents, solvents, building materials, laboratory reagents, pharmacy chemicals, and anesthetic leakage. In hospitals, poor VOC control can affect indoor environmental quality, occupational safety, patient comfort, and the safety of vulnerable populations such as respiratory patients, elderly patients, immunocompromised patients, and neonatal or intensive-care patients.

Conventional VOC monitoring approaches are often divided between laboratory-grade analytical instruments that are accurate but expensive and non-portable and consumer-grade air-quality meters that are inexpensive but insufficiently reliable for hospital use. To address this gap, this paper presents VolaSens, a portable hospital-oriented VOC sensing device for real-time indoor air quality surveillance and early warning of abnormal VOC accumulation. The proposed system integrates a hybrid VOC sensor architecture, environmental compensation using temperature and humidity sensing, embedded signal conditioning, alarm functions, wireless communication, and a disinfectant-compatible handheld enclosure. A prototype development plan, technology readiness assessment, field testing strategy, business and regulatory considerations, and ethical use framework are summarized. Preliminary field measurements were collected across three hospitals and multiple clinical locations. The results indicated location-dependent VOC variability, with higher values observed in areas such as blood collection rooms, oral implantology areas, and emergency departments. Repeatability analysis using mean concentration, standard deviation, mean relative error, and coefficient of variation demonstrated the importance of calibration, environmental compensation, and location-specific interpretation. The paper concludes that a portable, calibrated, hospital-specific VOC monitoring platform can support environmental safety management, ventilation assessment, and smarthospital air quality surveillance, provided that its limitations, intended use, and regulatory claims are clearly defined.

16:42 Highly Sensitive and Selective Detection of Dimethyl Diselenide by Human OR2T Receptors

Yosuke Fukutani (Tokyo University of Agriculture and Technology, Japan)

Volatile selenium compounds are potent malodorants characterized by extremely low odor thresholds; however, the molecular basis of their detection remains poorly understood. In this study, we investigated the recognition of selenium-containing odorants by human olfactory receptors (ORs) and identified OR2T1 and OR2T11 as highly sensitive receptors for dimethyl diselenide (DMDSe). OR2T11 exhibited strong, selective responses to DMDSe compared to structurally related sulfur- and selenium-containing compounds, including dimethyl sulfide (DMS), dimethyl disulfide (DMDS), and dimethyl selenide (DMSe). This receptor activation was dependent on transition metal ions and exhibited distinct metal ion selectivity profiles, supporting a metal-coordination mechanism for the recognition of selenium-containing odorants. These results suggest that OR2T11 function as specialized detectors for volatile chalcogen compounds. To evaluate their applicability for odor detection, we analyzed headspace samples from real-world sources. The headspace generated from mixtures of perm solution and human hair strongly activated OR2T1 and OR2T11, whereas the perm solution alone elicited a negligible response, suggesting the generation of DMDSe during the perming process. Furthermore, these receptors successfully detected trace amounts of selenium-derived contaminants in beverage samples via vapor-phase measurements. Together, our findings identify OR2T1 and OR2T11 as key receptors for volatile selenium compounds and provide mechanistic insights into the highly sensitive and selective detection of DMDSe by the human olfactory system.

17:00 Portable NDIR CO_2 Monitoring Device for Real-Time Hospital Indoor Air Quality and Ventilation Assessment

Tingting Wu, Yichen Lin, Yuxuan Chen, Jiayue Yang and Sumedha N. Prabhu (The Chinese University of Hong Kong, Shenzhen, China)

Indoor carbon dioxide concentration is widely used as a practical proxy for occupancy-related ventilation adequacy in indoor environments. In hospitals, inadequate ventilation may contribute to discomfort, fatigue, poor air renewal, accumulation of exhaled air, and reduced environmental safety in crowded waiting areas, wards, consultation rooms, and support spaces. Fixed building-management systems can provide continuous monitoring, but they are often expensive, infrastructure-dependent, and unsuitable for rapid room-to-room ventilation auditing. Consumer-grade CO_2 monitors are more affordable but may lack traceable calibration, hospital-compatible documentation, and professional data-management features. This work presents CO_2- Guardian HospAir, a portable non-dispersive infrared CO_2

monitoring device for real-time hospital indoor air quality and ventilation assessment. The proposed device integrates a miniaturized NDIR CO_2 sensor, temperature and humidity compensation, optional pressure compensation, microcontroller-based signal processing, real-time display, threshold alarms, data logging, rechargeable battery operation, and optional wireless connectivity. The system is intended for environmental monitoring by hospital facility managers, biomedical engineers, environmental health and safety personnel, and ventilation-maintenance teams. It is not intended for patient diagnosis, respiratory monitoring, pathogen detection, or direct infection-risk quantification. Preliminary hospital field measurements from three anonymized hospitals showed locationdependent CO_2 concentrations, with generally small standard deviations across repeated measurements, supporting the feasibility of the prototype for spot-check ventilation assessment. The analysis emphasizes that portable CO_2 monitoring can support evidence-based hospital ventilation management calibration, contextual interpretation, intended-use clarity, and responsible data governance.

15:30 to 17:18

S8B: ONLINE SESSION #2

Room: 14SCO T3

Chairs: Sumedha N. Prabhu (The Chinese University of Hong Kong, Shenzhen, China)

and Thi Phuoc Van Nguyen (Homeguardian.ai, Australia)

15:30 Digital Twins for the Real-Time Assessment of Plants: An IoT-Based Architecture with Synchronized 3D Virtual Representation

Afonso da Silva Taveira (Iscte-Instituto Universitario de Lisboa, Portugal); Octavian Adrian Postolache (Iscte-IUL and Instituto de Telecomunicacoes & IT- Instituto de Telecomunicacoes, Portugal); Rui Neves Madeira (Faculdade de Ciências e Tecnologia - Universidade Nova de Lisboa, Portugal)

Continuous and precise monitoring of plant health and microclimatic parameters is essential to optimize water usage and prevent physiological stress in precision agriculture and indoor cultivation. This work applies the Digital Twin (DT) concept to the assessment of plants, creating a virtual model that mirrors the physical entity with real-time monitoring of its growth, water consumption, and reaction to lighting changes. The system is centered on an ESP32 Dev Kit V1 microcontroller, a Digital Thread built on Firebase Realtime Database, and a Virtual Space developed in Unity3D, where a dynamic 3D plant model shapes itself from the physical sensor telemetry. A linear decision model prescribes the irrigation duration from sensor readings and local weather, and a local safety override blocks actuation whenever the water reservoir runs low, and the model is evaluated offline on the logged inputs. Multi-day field logging (121.9 h, 3818 samples) is used to characterize the sensor calibration, noise, and response to environmental conditions, and the reliability of the uplink: temperature, light, and soil moisture were stable and physically plausible, soil moisture showed a single-sample noise of about 7.5 percentage points, and 98.5% of the 60 s uplink intervals met their nominal period. An analytical estimate of the uplink response time (about 2.75 s on average) is also given.

15:48 Graphene/PEDOT: PSS-Based Electrochemical Devices for Glucose Sensing Applications

Aniket Chakraborthy, Monlisa Ghosh and Anindya Nag (Technische Universität Dresden, Germany); M. Ercan Altinsoy (Dresden University of Technology, Germany)

The paper presents the design, development and implementation of graphene nanocomposite-based electrochemical sensors. Graphene nanocomposites have proven to be highly effective in detecting ions with high sensitivity and selectivity thanks to their large surface area, improved electron transfer, and high chemical stability. Graphene has been mixed with PEDOT: PSS at fixed ratios to form efficient glucose-sensing applications. The prototypes were capable of successfully detecting spiked glucose solutions after they were integrated with glucose oxidase on glassy carbon electrodes. The operating range,

impedance sensitivity and detection limit of the sensors were 100-1000 ppm, 28.05±1.4 mΩ/ppm and 1 ppm, respectively. The sensitivity of the sensor, derived from the slope of the impedance versus glucose concentration calibration curve, was calculated to be 28 mΩ/ppm. The capability of the developed sensors to detect glucose ions at various concentrations successfully provided a platform for devising a fully functional glucose sensing system.

16:06 Low-Cost IoT Soil Monitoring with a 7-in-1 Probe: Data-Chain Integrity and Operating Limits of Indirect NPK Measurement

João Rodrigues (Iscte - Instituto Universitario de Lisboa, Portugal); Octavian Adrian Postolache (Iscte-IUL and Instituto de Telecomunicacoes & IT- Instituto de Telecomunicacoes, Portugal); Joaquim Mendes (Faculdade de Engenharia da Universidade do Porto, Portugal & INEGI, Portugal)

Low-cost multiparametric soil probes are increasingly used in Internet of Things (IoT) monitoring systems. However, their behavior under real operating conditions is rarely characterized. This article presents IOT- NSOIL, a low-cost soil monitoring system consisting of an ESP32-WROVER-B microcontroller, a 7-in-1 probe with a Modbus RS485 interface, MQTT over Wi-Fi, Node-RED and InfluxDB, developed according to the Design Science Research methodology and evaluated in two independent nine-day cycles on six potted basil plants subjected to three irrigation regimes. Across 18 sessions and 5392 readings, the data chain preserved all readings at the configured cadence of 5 s, with no gaps, even though messages were sent without delivery confirmation (MQTT QoS 0). Two silent failures were identified in the application layer, a database identifier mismatch and the mislabeling of experimental units; neither raised an error, and both were detected only by manual inspection. The moisture variation between consecutive days reversed sign depending on the occurrence of irrigation, with median decreases of 4.5 and 3.8 percentage points on days without irrigation and increases of 1.0 and 0.9 points on days with irrigation, reproducibly across cycles. The nitrogen, phosphorus and potassium values behaved as indirect measurements, computed from the electrical conductivity through linear equations: their correlations with conductivity exceeded 0.998, their ratios to it remained constant and the intercepts were close to zero. The conductivity was unavailable below about 14 to 18% moisture, which affected 72.2% of the observations, and the pH proved to be unstable. The results demonstrate that, in systems of this type, the limiting factor is the sensing layer, not the IoT infrastructure.

16:24 Flexible All-Polymer Screen-Printed Pressure Sensors for Strain Sensing Applications

Aniket Chakraborthy, Monlisa Ghosh and Anindya Nag (Technische Universität Dresden, Germany); M. Ercan Altinsoy (Dresden University of Technology, Germany)

The paper presents the work done on the fabrication, characterization, and implementation of flexible pressure sensors. The novelty of this work lies in the design and development of all-polymer flexible sensors, which are not yet available in the literature. The prototypes were formed using the screen-printing technique, thereby achieving a simple, facile, and quick roll-to-roll production process. Due to the high mechanical flexibility of the sensors, they were characterized through bending, stretching, and twisting tests. The initial results provide a strong foundation for integrating these sensors into embedded circuitry to form a fully functionalized polymer-based strain-sensing system.

9:00 to 10:30

S9A: INTELLIGENT SENSING SYSTEM FOR SUSTAINABLE MINING AND MINERALOGY - SPECIAL SESSION

Room: 14SCO T2

Chair: Abhijeet Gorey (Tata Consultancy Services, India)

09:00 A Quadrupedal Robotic Sensing Suite for Spatial Environmental Monitoring

Christopher Ayoub, Benjamin Brandwood, Sanuth Desitha Wadasinghe, Nethum Dhammika Payagalage, Dinuk Ashan Wijesinghe, Channa Pradeep Don, Payam Zarafshan and Karthick Thiyagarajan (Western Sydney University, Australia)

Environmental monitoring in dynamic environments requires mobile sensing platforms capable of collecting spatially referenced data. This paper presents a low-cost environmental monitoring system integrated with a quadrupedal robot for spatial monitoring. The proposed system combines an ESP32-based multi-modal sensing module with ROS 2 Humble, LiDAR mapping, and machine learning to enable synchronized acquisition of environmental measurements and robot localization data. The sensing module incorporates CCS811, BMP180, DHT11, and MQ-2 sensors to measure eCO2, TVOC, temperature, humidity, atmospheric pressure, and combustible gas response. Environmental measurements are synchronized with LiDAR point clouds, odometry, and coordinate transformations to generate spatially referenced datasets. Experimental validation across 25 robotic traversals produced 21,095 synchronized environmental-robot data samples. Random Forest and feed-forward Artificial Neural Network models were evaluated for eCO2 prediction using robot motion, position, timing, and LiDAR-derived features. The Random Forest model achieved the best performance, with an RMSE of 178 ppm, an MAE of 89 ppm, MAPE of 8.3%, and an R2 value of 0.95, outperforming the artificial neural network model. The results demonstrate the feasibility of integrating lowcost environmental sensing, quadrupedal robotics, spatial mapping, and machine learning within a unified framework for intelligent environmental monitoring. The proposed system provides a scalable and costeffective foundation for future autonomous monitoring applications in industrial, hazardous, and outdoor environments.

09:18 Design and Analysis of Impedance Measurement Electronics for Foreign Object Detection

Campbell Suter, Bill Heffernan, Michael Hayes and Niloofar Rezaei (University of Canterbury, New Zealand)

To avoid product contamination, the food and beverage industry must detect small foreign object contaminants in aqueous products. This paper presents the design and analysis of driver electronics intended to detect such objects via impedance changes in such products flowing through a recently developed in-line sensor. The main contribution is the application of an electronic source bridge to foreign object detection, accounting for constant changes in fluid conductivity due to temperature changes. The system was able to clearly detect 2 mm oblate silver spheres in 0.5 S/m saline solution.

09:36 Electrospun ZnO-Doped Polyhydroxybutyrate Nanofibers for Piezoelectric Transduction

Milad Razbin (University of Sydney, Australia)

Electrospun biodegradable piezoelectric nanofibers provide a promising platform for flexible, self-powered transducers with reduced environmental persistence. In this work, zinc oxide (ZnO)-doped poly(3hydroxybutyrate) (P3HB) nanofibers were fabricated and optimised by combining response surface methodology, artificial neural-network (ANN) modelling, and a genetic algorithm (GA). Fifteen experiments were used to examine the effects of ZnO concentration, applied voltage, drum speed, and deposition time on the normalised piezoelectric voltage. The ANN-GA framework identified 4.3 wt.% ZnO, 16 kV, 7.7 m/min, and

10.5 h as the optimal conditions. Experimental validation produced 0.306 mV/kPa, with an 8.13% prediction error. The optimised mat exhibited an average fiber diameter of 1450 nm, a toughness of 37.28 MJ/m³, a maximum sensitivity of 0.776 mV/kPa at 1.75 Hz, and stable output over 1000 compression cycles. Accelerated enzymatic degradation caused approximately 38% mass loss after six weeks, accompanied by a progressive reduction in piezoelectric output. Proof-of-concept demonstrations further showed that the nanofiber transducer could detect spatial plantar loading, finger motion, and respiratory motion. These results highlight ZnO-doped P3HB nanofibers as versatile biodegradable piezoelectric transducers for wearable sensing.

09:54 **Special talk by Dr. Abhijeet Gorey** (Tata Consultancy Services, India) on Intelligent Sensing System for Sustainable Mining and Mineralogy

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9:00 to 10:30

S9B: SENSORS FOR CHALLENGING APPLICATIONS

Room: 14SCO T3

Chair: Krishanthi Jayasundera (University Technology Sydney, Australia)

09:00 **MXene-PDMS Nanocomposite Based Triboelectric Nanogenerator for Real-Time Application**

Sheetal Sharma (IIT Dhanbad, India); Shiva P (Curtin University of Technology, Australia); Vinod Kumar Singh (Indian Institute of Technology (Indian School of Mines), India)

The flexible triboelectric nanogenerator (FTENG) was fabricated for biomechanical energy harvesting to meet worldwide energy demand. This manuscript presents a synthesis of Ti3C2Tx MXene, which was utilized to fabricate a flexible triboelectric nanogenerator (FTENG) for biomechanical energy harvesting and LED lighting. Initially, Ti3C2Tx MXene was synthesized by etching the MAX phase precursor, as confirmed by various characterization techniques. Then the MXene-PDMS-based FTENG was fabricated using an ITO-PET electrode, which produced an output voltage of 120 V and a current of 2 μA. The enhanced output voltage of the device is attributed to the high electronegativity, charge-trapping sites, dielectric polarization, and conductive pathways contributed by MXene. Then the device is used to harvest energy from biomechanical motion, such as finger tapping, finger bending, Toe tapping, and device bending. The higher the applied force during motion, the higher the device's output performance. Then the device is used for a real-time application to glow LEDs. This demonstrates the potential of the FTENG device as a flexible, self-powered platform for wearable motion sensing and low-power portable electronics.

09:18 **Nonlinear Optimization Approach to Demand Response Using Polynomial Utility and Linear Cost with Integer Variables**

Taketo Azuma (Utsunomiya University, Japan); Radhika Sudha (Birla Institute of Technological Sciences, Pilani, Hyderabad Campus, India)

This paper considers demand response problems with nonlinear utility functions and linear cost functions by using mixed integer nonlinear programming. The considered demand response problems are formulated as multi objective mixed integer nonlinear optimization problems to minimize the power demand and the linear cost and maximize the utility performance indices which are described as polynomials. A method to reduce the formulated mixed integer nonlinear optimization problems to nonlinear optimization problems without integer variables. The effectiveness of the proposed approach is validated in a numerical case study.

09:36 Reliability-Aware Control for Cooperative Flight

Sheldon Moonjelil, Suzanne Dsouza and Medha Kumble (Macquarie University, Australia); Alice James (Macquarie University, NSW, Australia); Avishkar Seth and Subhas Chandra Mukhopadhyay (Macquarie University, Australia)

Biological swarms, such as schooling fish and flocking birds, navigate confined environments using local sensory feedback. This paper proposes a framework for two Crazyflie nano-quadrotors, denoted D1 and D2. D1 executes a prescribed flight pattern, while D2 uses onboard visual observations of D1 to regulate their relative configuration. Inspired by local visual sensing in biological flight, the method combines an alpha-beta filter for smoothing visual features with reliability-aware control. Detection confidence, temporal consistency, and observation age modulate D2's motion commands, with supervisory logic for tracking loss and reacquisition. The architecture targets onboard perception using the AI-deck GAP8 processor, supported by Flow Deck and inertial sensing for local flight stabilisation. A YOLOv8n base detector trained on a Crazyflie image dataset achieved test mAP@0.50 of 99.50% and mAP@0.50:0.95 of 79.70%. An analytical resource assessment identifies memory requirements relevant to onboard deployment. A comparative evaluation across hover, lateral, circular, and sinusoidal flight assesses formation accuracy, tracking continuity, and recovery under degraded observations, with experimental results demonstrating synchronised relative motion patterns and estimator-based RMS separation errors of 5.3-12.2 cm during sustained flight in confined corridors without external localisation anchors

09:54 A Screen-Printed Electrochemical Sensor for Selective Lactate Detection and Reusable Sensing

Jerome Rajendran, Shingirirai Chakoma and Rahim Esfandyarpour (University of California Irvine, USA)

Lactate is an important physiological biomarker for assessing metabolic activity, physical performance, and disease progression. Although electrochemical lactate sensors have been widely investigated, achieving robust, selective, and reusable sensing remains a challenge due to the limitations associated with conventional biological recognition elements. In this work, we present a flexible screen-printed electrochemical lactate sensor fabricated using a scalable printing process and a synthetic recognition layer formed through electropolymerization. The analytical performance of the sensor was systematically evaluated through chronoamperometric measurements over physiologically relevant lactate concentrations. The sensor exhibited a concentration-dependent electrochemical response with good linearity and reproducibility. Selectivity studies demonstrated minimal interference from common sweat constituents, while repeated sensing and regeneration experiments confirmed stable performance over multiple measurement cycles. The screen-printing fabrication approach eliminates the need for complex cleanroom microfabrication, enabling low-cost and scalable sensor production. These results demonstrate the potential of the proposed electrochemical sensing platform for reliable and reusable lactate detection and provide a promising foundation for future integration into flexible wearable sweat sensing systems.

10:12 A Multimodal Electrochemical Sensor for Joint Pesticide and Fertilizer Sensing in Soil: Architecture, Physicochemical Model, and Cross-Soil Validation Strategy

Gabriel Antonesei, Mihaela Zaulet and Adrian Fratila (Zenido Inovation SRL, Romania)

Precision agriculture requires information not only on nutrient availability but also on pesticide residues and on the physicochemical state of the soil that perturbs electrochemical measurements. This paper proposes a multimodal electrochemical sensor that combines (i) a compositionally diverse TiO2/CuO electrode array interrogated by square-wave, differential-pulse and cyclic voltammetry for organophosphorus-pesticide fingerprints; (ii) nitrate, ammonium and potassium ion-selective electrodes; (iii) an IrOx solid-state pH electrode; and (iv) broadband soil/electrode electrochemical impedance spectroscopy. The central hypothesis is that fertilizer-ion activity, pH, water-mediated ionic transport and soil texture are

not merely interferences, but measurable state variables that can be used to compensate pesticide voltammograms. A joint mathematical model is developed from Nernst/Nikolsky-Eisenman potentiometry, proton-coupled pesticide redox chemistry and equivalent-circuit impedance representations. The proposed ADuCM355-based acquisition platform sequentially collects open-circuit potentials, voltammetric responses and impedance spectra, followed by feature-level fusion and multitask regression/classification. A leave-one-soil-type-out protocol is proposed to test whether multimodal sensing generalizes better than pesticide voltammetry alone.

11:00 to 12:30

S10A: SENSOR APPLICATIONS

Room: 14SCO T2

Chair: Takehito Azuma (Utsunomiya University, Japan)

11:00 VSL26: A Pipeline for Translating Vietnamese Medical Prescriptions into Sign Language

Trong Phuc Nguyen, Loc Van Nguyen and Thuy T. Pham (University of Technology Sydney, Australia); Thao Thanh Nguyen (Computing & Health Science Research Center, Vietnam); Stuart W. Perry (University of Technology Sydney, Australia)

Deaf patients in Vietnam face major barriers to written medication instructions, and no automated system currently translates Vietnamese prescriptions into Vietnamese Sign Language (VSL). We present VSL26, a prescription-to-sign-language pipeline that converts Vietnamese prescription images into VSL-oriented gloss representations for expert review. The pipeline compares an EasyOCR/VietOCR and LayoutLMv3 namedentity-recognition (NER) baseline against a vision-language model (VLM) extraction path. Both paths feed a shared intermediate representation, a medication knowledge base for brand-to-generic normalisation, and a rule-based gloss generator whose intermediate artifacts are retained for clinical auditability. Sliding-window inference and bounding-box association link drug names to dosing instructions in the baseline path, while evidence-text fields make VLM outputs inspectable. Evaluation covers three stages: LayoutLMv3 NER on an internal held-out split of VAIPE prescription annotations, a paired extraction-yield comparison on a 30-image mixed prescription set, and expert review of VLM-generated glosses by ten Deaf Vietnamese community members from seven provinces. The LayoutLMv3 component reaches micro-F1 = 0.999 on the internal split. On the mixed set, the VLM path yields more extracted drugs, mapped drugs, complete usage instructions, and gloss-ready outputs than the OCR-LayoutLMv3 path. Across 300 expert ratings, the mean score is 3.98/5, with 78.0% of ratings in the 4-5 range. These pilot results support VSL26 as a reproducible prescription-togloss pipeline and motivate future child comprehension studies.

11:18 Self-Sensing Target Position Estimation for Mid-Air Ultrasound Haptics via Time-of-Flight Ultrasound Ranging

Daisuke Mizushima and Rin Furuya (Aichi Institute of Technology, Japan)

In recent years, mid-air haptics has attracted attention as an intuitive human interface in AR/VR applications. However, conventional devices require hundreds of speakers and external sensors, limiting their use to stationary installations. This study proposes a self-sensing scheme in which a compact actuator consisting of eight ultrasonic transducers detects the target position through time-of-flight ranging. Two receiver configurations were fabricated and compared: a phase-optimization-based receiver, which adds minimal receiving circuitry to our previous setup, and a high-precision receiver, which incorporates a masking signal and a centrally placed transmitter. Position estimation was performed using both grid search and the extended Kalman filter. The high-precision receiver achieved an average positional error of 1.5 mm and a maximum error of 4.8 mm, demonstrating that the proposed system can localize a target with an accuracy comparable to the two-point discrimination threshold of human skin.

11:36 Deep Neural Networks for Material Classification Using Simulated TouchNet GelSight-Based Visuotactile Data

Nathaniel Ashton R. Olivan and Ronnie Concepcion II (De La Salle University, Philippines)

Visual data alone may not suffice for material identification particularly when surfaces lack identifiable marks or patterns, making accurate classification challenging for conventional lightweight machine learning approaches. While existing solutions implement neural network architectures for the visuotactile object identification, they limit themselves to one model, not exploring how differing architectures may perform given the same dataset. This study explores three deep learning architectures of differing complexity and network configurations namely, a classical Convolutional Neural Network (CNN), ResNet18, and a hybrid CNN-Transformer model (TransCNN), for material classification given visuotactile data. All models are trained and evaluated on the ObjectFolder 2.0 dataset, containing visuotactile data generated by TouchNet, a software simulating the outputs of a GelSight tactile sensor, which possesses 1000 objects across four general materials, wood, polymers, metals, and ceramics, wherein performance is assessed using object-level classification accuracy, precision, recall, specificity, MCC and F1-score. With this, CNN achieved the highest accuracy of 79.93%, and F1-score of 0.70 marginally outperforming both ResNet18 and TransCNN. The CNN model also demonstrates superior computational efficiency, being 0.35 ms per image faster compared to TransCNN, and possessing 3.67 times less MACs. These results reveal that for visuotactile material classification at this dataset scale, simpler convolutional architectures remain competitive, and that Tranformer-CNN hybrid models require larger datasets to maximize their potential. This implies that simple CNN-based model provides better material classification accuracy while maintaining lower computational cost, allowing such the base architecture to be the ideal choice when developing more complex models for real-world tactile sensing applications.

11:00to 12:30

S10B: WOMEN IN SENSING WORKSHOP

Room: 14SCO T3

Chair: Subhas Chandra Mukhopadhyay, Macquarie University, Australia

11:00 Introduction of the workshop and welcome

Speakers:

11:10 Dr. Thi Phuoc Van Nguyen, Homeguardian.ai, Australia

Beyond Fall Detection: Intelligent Activity Monitoring for Proactive Fall Risk Mitigation

Falls pose a serious threat to the safety, independence, and quality of life of older adults. Traditional fall detection systems identify falls only after they occur, but emerging AI technologies make it possible to assess and reduce fall risk before an incident happens.

This presentation describes the development of an intelligent sensing system that combines computer vision, deep learning, and activity recognition to monitor daily activities continuously and detect movement patterns linked to higher fall risk. By analysing posture, movement dynamics, and interactions with the surrounding environment, the system aims to flag potentially hazardous situations early.

The talk will cover the key engineering challenges, practical applications, and the potential of AI-driven monitoring to enable timely interventions, reduce fall-related injuries, and support safer, more independent living for older adults.

Biography:

Dr Thi Phuoc Van Nguyen is a Scientist and AI Developer at HomeGuardian.AI, where she designs and deploys AI-driven solutions for smart home and IoT-based monitoring systems, including end-to-end data pipelines from collection and labelling through to model training and validation. Her work sits at the intersection of intelligent sensing, artificial intelligence, and digital health.

Before joining HomeGuardian.AI, she was a researcher and casual lecturer at the Centre for Health Research, University of Southern Queensland, and a researcher at Japan's National Institute of Information and Communications Technology (NICT), where she led a digital health project on how environmental factors and daily activity affect sleep quality.

Van holds a PhD from Massey University, New Zealand, where her thesis on non-contact radar sensing for vital sign detection was named to the Dean's List of Exceptional Theses. She also holds a Master of Science with Distinction from Vrije Universiteit Brussel, Belgium. Her research has appeared in Sensors, IEEE Access, and Scientific Reports.

11:30 Dr. Sumedha Nitin Prabhu, The Chinese University of Hong Kong, Shenzhen

From Biosensor Innovation to Early Diagnostics Research Leadership

Advances in biosensing require not only innovative technologies but also diverse perspectives, collaborative teams, and opportunities for researchers to thrive. This talk will present research activities on biomedical sensing and discusses the challenges and opportunities facing women in interdisciplinary research.

Drawing on her doctoral, postdoctoral, and faculty work in Australia, the United States, and China, she will highlight research on MEMS-based sensing for kidney health monitoring, nutritional assessment, exosome detection, post-knee surgery healing/anti-infection diagnostics, and Organ-on-Chip: a brain organoid microfluidic device development, wirelessly monitoring the knee synovial fluid quality for pain management, and monitoring post-surgical patient ligament movement, air quality monitoring, etc. These examples illustrate key challenges in translating biosensors into practical healthcare technologies, including sensor functionalization, selectivity, repeatability, affordability, and device integration.

Her advanced work also introduces research directions at The Chinese University of Hong Kong, Shenzhen, focusing on miniaturized biosensing platforms, biomarker-based early diagnostics, inflammaging management, microfluidic and organ-on-chip technologies, and developing a closed-loop neural biosensing and stimulation platform that monitors dopamine and inflammatory biomarkers in real time to enable adaptive, targeted treatment of Parkinson's disease, alongside student engagement in medical device development. Beyond the technical challenges, the talk will consider issues relevant to women pursuing research careers, including professional visibility, access to mentorship and networks, navigating international career transitions, and balancing research, teaching, and academic service. It will explore how supportive mentorship, interdisciplinary collaboration, and inclusive research environments can help early-career researchers build confidence and progress toward leadership.

By connecting biosensor development with researcher development, this talk aims to encourage women in sensing to pursue impactful healthcare research and help shape a more inclusive scientific community.

Biography:

Dr. Sumedha Nitin Prabhu (SM'17, M'21, SM'26) received her B.Sc. and M.Sc. in Biotechnology from the University of Mumbai, India, in 2011 and 2013, respectively, and her Ph.D. in Biomedical Engineering from Macquarie University, Australia, in 2022. She completed postdoctoral appointments at the University of Newcastle, Australia, and the

University of Cincinnati, USA. Her research focuses on biomedical engineering, nanobiotechnology, MEMS-based biosensors, biomarker detection, functionalized biomaterials, exosomes, microfluidics, organ-on-chip systems, and wearable and implantable technologies for early diagnosis and point-of-care healthcare. She mentors students in developing innovative, miniaturized diagnostic devices.

Dr. Prabhu has published journal articles and book chapters and presented at international conferences and poster competitions. Her distinctions include two People's Choice Awards, a Silver Award, the second "Best PhD Thesis 2021" prize, scholarships, research funding, and international competitive grants. She has reviewed over 360 scientific manuscripts for 54 international journals and served as a reviewer for 10 IEEE conferences. Her professional contributions include conference programme committee membership, invited special session chair roles, and participation as a Young Women in Sensors (WiSe) panelist. She received the IEEE Transactions on Instrumentation and Measurement "Outstanding Reviewer of 2024" recognition and was named among MDPI's 2024 Top 1000 Reviewers. She became an IEEE Senior Member in July 2026.

Dr. Prabhu serves as Associate Editor for PriMera Scientific Engineering, Guest Editor for special issues in MDPI Biosensors and Frontiers in Lab on a Chip Technologies, and Invited Leading Editor for AI in Clinical Trials and Research Systems. Her work advances biosensing technologies for actionable healthcare diagnostics and monitoring.

11:50 Dr. Alice James, Macquarie University, Australia

From Sensors on Robots to Robots as Sensors: Trends in Autonomous Systems

Sensors have moved from being attached to a single robot to being shared across teams of robots that sense together. This talk traces that shift through my own research: from wearable posture and hand-tracking systems and vision-driven ground vehicles, to sensor fusion for indoor drone navigation and neuromorphic (event-based) sensing for high-speed counting, and on to cooperative drone systems at Macquarie University's Advanced Drone Systems Research Centre. I will show how multiple drones share sensing tasks: handing off a tracked target mid-flight, and fusing sensor data to carry payloads together. Along the way, I will highlight related trends in robotics, including collaborative perception, event-based vision, navigation without GPS or radio links, onboard edge AI and aerial manipulation, and point to opportunities where sensing research can shape the next generation of autonomous robot teams.

Biography:

Dr Alice James is a Senior Research Officer in Robotics and Drone Systems at the Advanced Drone Systems Research Centre (ADSRC), Macquarie University, Sydney, where she is a founding member. She completed her PhD in Robotics Engineering at Macquarie University in 2025, then worked as a postdoctoral researcher at ADSRC before taking up her current role in 2026. Her research focuses on aerial robot autonomy, avionics and sensing systems, including multi-drone cooperation, mid-air handoff and docking, cooperative payload transport and marine monitoring. With over 275 citations, she has published in top-tier venues including ACM MobiCom, MobiSys, ICSE, the IEEE Sensors Journal, and IEEE ROBIO.

12:10 Ms Juthamas Hongoeb (Mahidol University and Macquarie University)

DEVELOPMENT OF SENSITIVE BIOSENSORS FOR INVESTIGATING HAZARDOUS PESTICIDES AND BIOMARKERS OF NEURODEGENERATIVE DISORDERS

The aging of the global population has driven a rising prevalence of dementia, of which neurodegenerative Alzheimer's disease is the most common form. The dementia cases have been projected to account for approximately 100 milion by 2050. Addressing this burden requires action across the disease continuum, from the reduction of modifiable risk to routine diagnosis at an early stage. Glyphosate herbicide was selected as the target for upstream prevention, as growing studies have indicated its potential neurotoxicity, whereas tau protein represents a significantly predictive biomarker for the diagnosis of neurodegenerative disorders. Although the gold standard analytical approaches of these analytes offer exceptional sensitivity and specificity, they demand centralized infrastructure, skilled operators, and lengthy workflows that limit their suitability for routine and field-based applications. This thesis thereby proposed impedimetric biosensors that could address above limitations. Two distinct recognition designs, utilizing aptamers and molecularly imprinted polymers (MIPs), were constructed on the cost-effective screen-printed carbon electrodes for the sensitive and selective detection of the designated targets. The aptasensor for glyphosate detection achieved the limit of detection (LOD) of 0.052 μM over a working range of 0.01–10.0 μM. The proposed aptasensor was also tested for its feasability against natural resources and commodities, yielding recovery percentages in the range of 87.8%–120.3%. The MIPs for tau detection achieved the LOD of 0.27 pg/mL over a working range of 0.005–10 pg/mL by using the IoT-enabled microcontroller-based sensing system. Spiked analysis in human serum also showed relative errors below 5% at all tested concentrations. Collectively, this work demonstrates versatile and cost-effective approches, offering a practical route toward decentralized monitoring spanning the prevention and diagnosis of dementia.

Biography:

Juthamas Hongoeb received the B.Sc. degree in medical technology from Mahidol University, Bangkok, Thailand, in 2022. She is currently pursuing the Ph.D. degree under a joint cotutelle program between the Faculty of Medical Technology, Mahidol University, and the School of Engineering, Macquarie University, Sydney, NSW, Australia.

Her research interests lie at the intersection of healthcare and engineering, with a focus on electrochemical biosensors for environmental and clinical diagnostics. Her work involves the design of aptamer-based and molecularly imprinted polymer sensors, electrode surface functionalization, and electrochemical impedance spectroscopy for the detection of hazardous pesticides and biomarkers of neurodegenerative disorders. Her fields of interests also include portable, microcontroller-based impedance analysers and IoT-enabled sensing platforms for point-of-care applications.

13:30 to 15:00

S11: CLOSING CEREMONY AND AWARDS

Room: 14SCO T2

Chair: Subhas Chandra Mukhopadhyay (Macquarie University, Australia)

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ICST 2026 PROGRAMME AT A GLANCE

MONDAY, 7TH DECEMBER

Time	Event	
09:00-09:30	S0: Opening session [14SCO T2]	
09:30-10:00	Morning Tea	
10:00-11:30	S1A: Battery and EV Sensing [14SCO T2]	S1B: Sensors for Physiological Monitoring [14SCO T3]
11:30-11:40	Break Time	
11:40-13:10	S2A: IoT and Remote Sensing [14SCO T2]	S2B: Capacitive and Magnetic Sensing [14SCO T3]
13:00-14:00	Lunch	
14:00-15:12	S3A: Thermal and Mechanical Sensing [14SCO T2]	S3B: Radar Sensing [14SCO T3]
15:15-15:45	Afternoon Tea	
15:45-17:15	S4A: Online Session #1 [14SCO T2]	S4B: Sensing related to Motors, Robots and Drones [14SCO T3]

TUESDAY, 8TH DECEMBER

Time	Event	
08:30-09:00	Late Registration	
09:00-10:30	S5: Keynote #1 and #2 [14SCO T2]	
10:30-11:00	Morning Tea	
11:00-12:30	S6: Keynote #3 and #4 [14SCO T2]	
12:30-13:30	Lunch	
13:30-15:00	S7A: Wearable Sensors and Activity Monitoring [14SCO T2]	S7B: Image Sensing [14SCO T3]
15:00-15:30	Afternoon Tea	
15:30-17:18	S8A: Bio-Sensing [14SCO T2]	S8B: Online Session #2 [14SCO T3] (ends 17:00)
18:30-22:00	Banquet Dinner at Lakeside Hotel & Conference Centre	

WEDNESDAY, 9TH DECEMBER

Time	Event	
09:00-10:30	S9A: Intelligent Sensing System for Sustainable Mining and Mineralogy - Special session [14SCO T2]	S9B: Sensors for Challenging Applications [14SCO T3]
10:30-11:00	Morning Tea	
11:00-12:30	S10A: Sensor Applications [14SCO T2]	S10B: Women in Sensing Workshop [14SCO T3]
12:30-13:30	Lunch Time	
13:30-15:00	S11: Closing Ceremony and Award [14SCO T2]	