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ARTIFICIAL INTELLIGENCE SOCIETY MALAYSIA (ARTIS)

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DATA TO DECISIONS: EMPOWERING GREEN ARTIFICIAL INTELLIGENCE AND STATISTICAL SCIENCES THROUGH RESEARCH AND INNOVATIONS

06 AUGUST 2025 | 8.00 AM - 5.00 PM |
AL-FARABI SEMINAR ROOM,
INSTITUTE FOR MATHEMATICAL RESEARCH (INSPEM),
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BOOK OF ABSTRACT

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Keynote Speaker 1

Dr. Azree Shahrel Ahmad Nazri

Head of Laboratory of Interdisciplinary Computing and Statistical Laboratory, Institute for Mathematical Research, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

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Towards Artificial General Intelligence: Quantum-Enhanced Large Language Models for Abstract Reasoning Through Hybrid Variational quantum circuit and Projected Entangled Pair States

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Abstract. A core obstacle in advancing quantum-enhanced large language models (LLMs) is the inherent unitarity of quantum circuits, which imposes rigid optimization constraints. These constraints can hinder convergence, reduce model flexibility, and limit the practical integration of quantum modules into classical architectures. This challenge becomes more pressing in tasks that demand high-level generalization, such as those found in the Abstraction and Reasoning Corpus (ARC), where traditional LLMs often struggle to reason beyond seen patterns.The primary objective of this research is to develop and evaluate a hybrid quantum-classical architecture that enhances abstract reasoning capabilities in LLMs despite the limitations introduced by quantum unitarity.To achieve this, we propose replacing conventional weight matrices in the Self-Attention and Multi-layer Perceptron (MLP) layers with a combination of Variational Quantum Circuits (VQCs) and Projected Entangled Pair States (PEPS). These quantum-inspired components are designed to capture complex correlations and enable the model to explore solution spaces more efficiently. The model will be trained and tested on ARC and similar reasoning benchmarks using hybrid optimization techniques.Expected outcomes include improved performance on abstract reasoning tasks, a deeper understanding of how quantum unitarity influences learning dynamics, and the development of design principles for integrating quantum modules into neural architectures.The significance of this research lies in its contribution toward building scalable, generalizable AI systems capable of advanced reasoning—while directly addressing the practical limitations of quantum integration in deep learning frameworks.

Keywords:Quantum Unitarity, Hybrid Quantum-Classical Architecture, Variational Quantum Circuits (VQCs), Abstract Reasoning Corpus (ARC), Generalization in Large Language Models (LLMs)

Keynote Speaker 2

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Enhancing Regression Diagnostics: Outlier Detection with Nu-Support Vector Regression

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Abstract. Many researchers overlook the significant impact of outliers on statistical estimates, often leading to inaccurate predictions and invalid inferential conclusions. In regression analysis, outliers, especially high leverage points (HLPs), which lie far from the bulk of the explanatory variable space, pose serious threats to model reliability. HLPs can distort model fitting, induce multicollinearity and heteroscedasticity, and obscure or exaggerate the presence of other outliers through masking or swamping effects. Their presence undermines the foundational assumptions of classical statistical methods, including normality and homoscedasticity, potentially causing complete methodological breakdown.This study proposes the use of Nu-Support Vector Regression (ν-SVR) as a diagnostic tool to detect outliers, with particular emphasis on identifying high leverage points in both low- and high-dimensional data settings. We demonstrate that ν-SVR provides an effective and computationally efficient approach for outlier identification, improving the robustness of statistical inference. The effectiveness of the method is validated through real-world case studies and supported by Monte Carlo simulations. These findings emphasize the importance of rigorous outlier detection before conducting statistical inference to ensure the reliability of conclusions drawn from regression models.

Keywords: High Leverage Points, heteroscedasticity, Monte Carlo simulations, Multicollinearity, Nu-Support Vector Regression, Outliers.

PARALLEL SESSION 1A

A Comparative Analysis of Machine Learning Models for Cardiovascular Disease Prediction

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Abstract. Cardiovascular disease (CVD) remains a leading cause of mortality worldwide, accounting for approximately 17.5 million deaths annually, with the highest burden observed in low- and middle-income countries. Early detection and prevention of CVD are crucial to improving public health outcomes and reducing associated socioeconomic burdens. However, the complexity of CVD risk factors, such as hypertension, hypercholesterolemia, poor dietary habits, and exposure to air pollution pose significant challenges for early diagnosis and intervention. Therefore, artificial intelligence (AI), particularly machine learning (ML), offers a promising approach to enhance the accuracy and timeliness of CVD prediction. This study proposes a predictive model for identifying individuals at risk of cardiovascular disease using various ML algorithms. A publicly available dataset was employed, and nine supervised learning models were evaluated: Decision Tree (DT), Random Forest (RF), Logistic Regression (LR), Gaussian Naïve Bayes (GNB), Support Vector Machine (SVM), Multi-Layer Perceptron (MLP), Extra Trees Classifier, and two gradient boosting methods (XGBoost and Light Gradient Boosting Machine (LightGBM)). Gradient boosting is a type of ensemble learning, which combines multiple weak learners to create a stronger predictive model. Ensemble learning typically refers to bagging, boosting, or stacking techniques. Prior to model training, univariate feature selection was applied to identify the most relevant predictive variables, thereby improving model performance and interpretability. Among the evaluated algorithms, the LightGBM model outperformed the others, achieving the highest predictive performance with an accuracy of 71.94%, a precision of 73.81%, a recall of 66.72%, and a F1-score of 70.09%. These findings demonstrate the potential of advanced ML models, particularly ensemble learning methods, in supporting early detection and clinical decision-making for cardiovascular disease, ultimately contributing to more effective healthcare strategies.

Keywords: Cardiovascular disease, machine learning, prediction

An Efficient Variant of RMIL Method with Sufficient Descent and Global Convergence under Strong Wolfe Line Search for Solving Image Restoration Problem

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Abstract. The Conjugate Gradient (CG) method is well-known for its efficiency in terms of convergence properties and low computational cost. A modified version of the Rivaie–Mustafa–Ismail–Leong (RMIL) CG method is proposed for image restoration problems. The parameters of the CG coefficient are redefined and presented based on the idea of utilizing some aspects of previous CG methods to retain their advantages. The search direction fulfills the sufficient descent condition and establishes the global convergence of the proposed algorithm under standard assumptions and the strong Wolfe line search. Numerical experiments provide strong evidence that the proposed method is more effective in solving a practical application of the algorithm in image restoration problems compared to other existing methods under the strong Wolfe line search.

Keywords: Image restoration; conjugate gradient; strong wolfe line search; RMIL; sufficient descent condition

Integrated Hybrid Algorithms for Multiple Imputation and Class Imbalance in Medical Datasets: A Comprehensive Review

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Abstract. The analysis of medical datasets is frequently complicated by the pervasive and interconnected challenges of missing data and severe class imbalance. These issues synergistically degrade the performance of predictive models, particularly for critical minority classes representing rare diseases or conditions. This report provides a comprehensive review of hybrid algorithms designed to address both data incompleteness and class skewness concurrently. It details the fundamental principles of Multiple Imputation (MI), including its three-stage process and Rubin's Rules for pooling, alongside an overview of established MI algorithms such as MICE, KNN, and Bayesian methods. Concurrently, the report elucidates the characteristics of class imbalance in medical data, its detrimental impact on traditional machine learning models, and various mitigation strategies, including data-level sampling (e.g., SMOTE) and algorithm-level techniques (e.g., cost-sensitive learning, ensemble methods). The review highlights several hybrid methodologies, ranging from sequential approaches (impute then balance) to integrated, balance-aware imputation methods like Conditional Generative Adversarial Networks (CGAIN) and clustering-based imputation. Effective evaluation of these complex algorithms necessitates a multi-faceted approach, assessing both imputation quality (e.g., RMSE, MAE) and classification performance using metrics appropriate for imbalanced data (e.g., Precision, Recall, F1-score, AUC-ROC, G-mean, Balanced Accuracy). Despite advancements, significant challenges persist, including the inherent difficulty in verifying the Missing At Random (MAR) assumption, computational intensity, model interpretability, and the potential for compounding biases. These methodological hurdles are deeply intertwined with critical ethical considerations, such as algorithmic bias against underrepresented groups, patient privacy, and the imperative to build trust in AI-driven healthcare. Future directions emphasize advancements in deep learning for integrated solutions, robust handling of Missing Not At Random (MNAR) mechanisms, enhancing model interpretability, and establishing standardized evaluation protocols, all while prioritizing equitable and ethical deployment of AI in healthcare.

Keywords: Multiple Imputation, Class Imbalance, Medical Datasets, Hybrid Algorithms, Machine Learning

A Survey on Dynamic Modular AI Systems for Knowledge Emergence: Architectures, Paradigms, and Challenges

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Abstract. In recent years, large language models (LLMs) have shown strong generalization abilities but also have limitations, including high costs, static knowledge bases, and reliability issues in specialized fields. To overcome these challenges, researchers are shifting from a single massive "omniscient model" to a modular AI system composed of lightweight, specialized models that work together. This paper provides a systematic review of this emerging area, focusing on real-time model hot-swapping, cost efficiency, and knowledge emergence. The paper outlines the core concept of encapsulating small models obtained through techniques like model distillation into standardized, deployable units. It categorizes existing research into three paradigms: (1) Mixture-of-Experts (MoE), highlighting the micro-level modularity and cost-effectiveness of sparse activation; (2) Tool-Augmented LLMs, which use a central LLM and dynamically invoke external models to enhance capabilities; and (3) Multi-Agent Collaboration, which fosters a decentralized network for solving complex problems. Additionally, the paper describes a four-layer architecture necessary for a dynamic modular system: (1) a model layer for standardized interfaces; (2) a routing/scheduling layer for intelligent task distribution; (3) an orchestration layer for managing workflows; and (4) a management center for real-time model onboarding/offboarding. Finally, the paper examines challenges such as latency, error propagation, context management, and inter-model consistency, while suggesting future research directions focused on system evolution, model capability language, and hybrid paradigms.

Keywords: Modular AI, Large Language Models (LLMs), Mixture-of-Experts (MoE), Tool-Augmented LLMs, Multi-Agent Collaboration

Drone Navigation Benchmarking Environment for Reinforcement Learning Agents

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Abstract. Reinforcement Learning (RL) has recently been used for various navigation purposes. However, drone navigation still lacks a unified navigation benchmark environment to compare the performance of multiple RL models. Current RL drone navigation models are tested on various custom environments that can't be directly compared without attempting to recreate the environments shown in the papers. In this paper, a drone navigation RL environment is proposed and the effects of obstacle count and goal distance are discussed. Three tiers are cre- ated based on obstacle count and goal distance and an agent is trained to show the differences between the tiers. It is shown that Tier three achieves a success rate that is 58% lower than Tier one and 50% lower than Tier two.

Keywords: Reinforcement Learning, Drone, Navigation, Simulation, Benchmark

Evaluation of Personal Radiation Exposure from Wireless Signals in Indoor and Outdoor Environments

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Abstract. With the development of wireless technology, the public is exposed to electromagnetic fields (EMF), which has led to concerns about the effects of radiation exposure from wireless signals. This paper aims to evaluate personal radiation exposure from wireless signals in indoor and outdoor micro-environments. According to the influencing factors, four different types of micro-environments are selected. A radiation exposure meter called ExpoM-RF 4 is used to measure the electric field strength of these micro-environments. From the measurement campaigns, three machine learning (ML) techniques are simulated to model the Electric Field Strength in each micro-environment. The ML techniques are Fully connected neural network (FCNN), eXtreme Gradient Boosting (XG Boost), and Linear Regression (LR) to predict the RMS and Maximum radiation exposure. From the ML models, Total Emission Ratio (TER), Root Mean Square Error (RMSE) and Coefficient of Determination (R^2) are evaluated to measure the performance of ML. By comparison, it is found that LR performs well with single and simple data sets, while XG Boost and FCNN demonstrate superior capabilities in handling multiple types of data sets. FCNN provides the most accurate predictions, particularly in urban and suburban areas where extreme values are observed. Finally, the measured data and the predicted radiation exposure levels are compared against public exposure limit by International Commission on Non-Ionizing Radiation Protection (ICNIRP), Malaysian Communications and Multimedia Commission (MCMC) and Federal Communications Commission (FCC). This study found that typically personal radiation exposure is lower than the international exposure limits (61.4 V/m). However, in areas with dense population and numerous base stations, the maximum exposure can approach 56.7365 V/m, which is close to the exposure limit.

Automated Soft Shell Crab Molting Detection Using Deep Learning-Based Image Processing

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Abstract. Aquaculture monitoring, particularly for soft shell crab farming, relies heavily on manual inspection methods that are labor-intensive and prone to human error. This paper presents an automated detection system for identifying molting stages in soft shell crabs using deep learning-based image pro- cessing. We compare the performance of YOLOv3 and YOLOv4 architectures on a dataset of 3,000 crab images captured un- der various environmental conditions. Our experimental results demonstrate that YOLOv4 achieves superior performance with 93.05% mAP, 93% precision, and 94% recall, outperforming YOLOv3's 91.90% mAP. The system provides real-time detection capabilities essential for optimal harvesting timing in commercial aquaculture operations. This work contributes to sustainable seafood production by reducing manual labor requirements and improving harvesting accuracy.

Keywords:Aquaculture, object detection, YOLO, molting detection, computer vision, deep learning

PARELLEL SESSION 1B

IRPCA-SIMPLS: A Robust SIMPLS Regression Method for High Dimensional Data with High Leverage Points

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Abstract. The Statistically Inspired Modification of Partial Least Squares (SIMPLS) is a variant from Partial Least Squares (PLS), which aim to model a regression between the regressor and the response variables for high-dimensional data. SIMPLS addresses multicollinearity problem while reducing the number of variables by projecting the original data into a lower-dimensional space. However, classical SIMPLS is vulnerable to outliers and high leverage points, reduces its ability to make accurate predictions. This study proposes a robust SIMPLS, where we integrated a proposed robust method of IRPCA and SIMPLS to reduce the effect of high leverage points, which we called, IRPCA-SIMPLS. We compare the proposed method to MRCD-PCA-RWSIMPLS, a recent robust variant of improvised SIMPLS based on MRCD-PCA weighting function, and SIMPLS using simulation study, evaluating the Mean Squared Error (MSE) of regression parameter estimates. Results from the simulation process demonstrates that IRPCA-SIMPLS outperformed the MRCD-PCA-SIMPLS and SIMPLS by consistently achieves the lowest MSE. This indicates that IRPCA-SIMPLS maintains the accuracy and stability of the estimated coefficients and is robust to contaminated datasets in high-dimensional settings, making it a reliable and robust alternative to MRCD-PCA-RWSIMPLS. Additionally, the IRPCA algorithm offers faster computational performance compared to MRCD-PCA-RWSIMPLS, making it an efficient alternative for robust high-dimensional regression. We further extend IRPCA-SIMPLS by developing a diagnostic plot to classify observations into four categories: regular observations, vertical outliers, and good and bad leverage points. Application on the Octane dataset, a widely used real-world high-dimensional dataset with HLPs, confirms the effectiveness of the proposed robust diagnostic plots by correctly classifying six known outliers as bad leverage points. While MRCD-PCA-RWSIMPLS provides comparable classification, several observations lie near the decision boundary. Classical SIMPLS, on the other hand, performs poorly in distinguishing between the groups.

Keywords: high-dimensional data, high leverage point, partial least squares regression, principal component analysis, SIMPLS

Rainfall Forecasting in Malaysia using SARIMA Model

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Abstract. Rainfall forecasting plays a vital role in flood mitigation, agricultural planning, and sustainable water resource management in Malaysia. However, the complex and regionallyvaried climate makes accurate prediction challenging. This study employs the Seasonal Autoregressive Integrated Moving Average (SARIMA) model to forecast monthly rainfall in three regions: Alor Setar (Kedah), Subang (Selangor), and Kuantan (Pahang), representing the northern, central, and east coast zones of Peninsular Malaysia. Monthly rainfall data from 2014 to 2023 were obtained from METMalaysia. For each region, SARIMA models were developed through Box-Jenkins modelling procedure which are model identification, parameter estimation, diagnostic checking and forecasting. The best model for rainfall forecasting were SA$ARIMA(3,1,0)(1,1,0)_{12}$ for Alor Setar, $SARIMA(4,1,0)(2,1,0)_{12}$ for Subang, and $SARIMA(0,1,1)(2,1,0)_{12}$ for Kuantan. All three models effectively captured seasonal rainfall behavior and produced forecasts aligned with historical patterns. The results demonstrate the capability of SARIMA models in modeling and forecasting rainfall patterns across diverse geographical regions in Malaysia. These findings offer practical value for early warning systems, infrastructure planning, and climate resilience strategies.

Keywords: Rainfall forecasting, SARIMA model, Time series analysis, seasonal pattern

Structural Equation Modelling of Self-Esteem, Motives of Participating in Physical Activity and Duration of Physical Activity among Adolescents in Kota Bharu, Kelantan

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Abstract. There were increasing in prevalence of sedentary lifestyles among youths which linked to major health risks such as cardiovascular disease, diabetes, and depression, underscoring an urgent need for interventions promoting active living. While motivation and self-esteem are recognized as key psychological factors influencing engagement in PA, limited research has validated their measurement and explored their interplay in the Malaysian adolescent context. This research addressed these gaps by translating and validating the Malay versions of two established instruments: the State Self-Esteem Scale (SSES-M) and the Physical Activity and Leisure Motivation Scale for Youth (PALMS-Y-M). The main aim of the study was to examines the structural relationships among self-esteem, motives for participating in physical activity (PA), and duration of physical activity in adolescents attending secondary schools in Kota Bharu, Kelantan. A cross-sectional design was employed. Participants were cognitively capable, Malay-speaking secondary school students who provided consent. Confirmatory Factor Analysis (CFA) was utilized to assess the factorial validity and reliability of both instruments. Model adequacy and sample size calculations were guided by Monte Carlo simulation, ensuring sufficient power for further structural equation modeling (SEM) analyses. A total of 783 samples with mean age of 14.51 years old (SD=1.25) and quite balance gender (male;57.3% vs female; 42.7%). The validity index of SSES-M (CFI=0.966, TLI=0.949, SRMR=0.030, RMSEA=0.040 (0.026,0.055), Clfit=0.861) and PALMS-Y (CFI=0.928, TLI=0.917, SRMR=0.048, RMSEA=0.045 (0.042,0.049), Clfit=0.982) shows that both are valid and reliable. The SEM model also shows good result (CFI=0.919, TLI=0.908, SRMR=0.048, RMSEA=0.044 (0.040,0.047) with significant direct and indirect significant paths between few variables under self-esteem, motivation to participate in PA and the duration of physical activity. This finding addresses the critical gap by offering validated measurement tools and novel data for the Malaysian adolescent population. Insights from this research can inform targeted interventions and policy efforts to foster active lifestyles and holistic well-being among youths, as well as generate awareness of the psychological determinants of PA engagement. Ultimately, this study aims to empower adolescents to develop sustained, health-promoting behaviors that will benefit both individuals and the broader community.

Keywords: structural equation modelling, physical activity, self-esteem, duration of physical activity, lifestyle

Exponentiated Weibull (EXW) Model with Covariate, Right and Interval Censored Data

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Abstract. To address the limitations of the Weibull distribution in modeling non-monotonic hazard functions, this study adopts the exponentiated Weibull (EXW) regression model, which accommodates monotonic, bathtub-shaped, and unimodal hazard patterns. The performance of the EXW regression is assessed under both right- and interval-censored data. A comprehensive simulation study was conducted across varying sample sizes, censoring proportions, and interval widths to evaluate maximum likelihood estimation (MLE) performance, both without and with imputation techniques, namely, midpoint, random, and survival function imputation, using bias, root mean squared error (RMSE), and standard error as evaluation criteria. The results indicate that the midpoint imputation method performed better than the other imputation techniques. The proposed framework was validated using the COM breast cancer dataset.

Keywords: Exponentiated Weibull distribution, midpoint imputation, interval-censored, covariate, imputation

RSM-Based Optimization of Heat Transfer in MHD Ternary Hybrid Nanofluid Flow over a Shrinking Surface

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Abstract. This study extends previous research on MHD stagnation flow of GO–TiO_2–Ag/water nanofluid over a shrinking surface by introducing an optimisation framework using Response Surface Methodology (RSM). The model accounts for magnetic field, radiation, and heat source/sink effects. Key input variables—magnetic parameter, heat source/sink intensity, and GO nanoparticle volume fraction—are selected for a Central Composite Design to evaluate their impact on thermal performance. The Nusselt number and skin friction coefficient are treated as response variables, representing heat transfer efficiency and flow resistance, respectively. Numerical solutions are obtained using MATLAB's bvp4c solver, and the resulting data are used to fit second-order polynomial models within the RSM framework. The regression models exhibit high accuracy ($R^2 = 1$). ANOVA confirms that heat source/sink, magnetic intensity, and nanoparticle concentration significantly influence heat transfer characteristics. Optimisation results reveal that a moderate magnetic field and optimised GO concentration enhance the Nusselt number while maintaining manageable skin friction. Combining numerical simulation and statistical optimisation, this integrated approach demonstrates a reliable strategy for improving thermal system performance using ternary hybrid nanofluids. Future work will explore entropy generation, experimental validation, and surrogate modelling for further design enhancement.

Keywords: Ternary hybrid nanofluid, MHD stagnation flow, heat source/sink, shrinking surface, response surface methodology

Modelling Urban Traffic Flow Predictions with Impacts of Important Locations in Transportation Network

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Abstract. Urban traffic flow plays a critical role in economic activity, environmental sustainability, and mobility within cities. Developing efficient transportation systems requires a solid understanding of traffic flow patterns and the ability to anticipate future trends. Modern technologies, such as sensors, data analytics, and predictive models, supported by Intelligent Transport Systems (ITS), are essential for improving road safety, traffic control, and decision-making. This study explores the potential of enhancing traffic flow forecasting by examining the effects of important locations within urban transportation networks. The research begins by identifying critical locations (or links) in the urban network using a centrality measure, specifically betweenness centrality. Traffic data from these locations are collected and used to develop time series models to forecast traffic flow. ARIMA-based modelling techniques are applied to investigate whether incorporating critical locations affects forecasting accuracy. The dataset is pre-processed and analysed using R, and the SARIMA model is tested using historical traffic data from urban locations in Chania, Greece. Model performance is evaluated using standard metrics such as MAPE and RMSE. Preliminary results suggest that including critical locations may contribute to modest improvements in forecasting accuracy. However, further investigation with larger datasets and additional urban areas is needed to confirm these trends. This study highlights the potential of integrating network analysis into traffic modelling and provides an early indication of how link criticality could inform future forecasting strategies. Future work may benefit from exploring more advanced techniques, such as Long Short-Term Memory (LSTM) models, to provide a deeper and more robust analysis.

Reducing Inappropriate Prescribing in Older Diabetic Patients

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Abstract. Medication errors (MEs) are a critical global health concern, particularly among older diabetic patients. These preventable errors occurring during prescribing, dispensing, or monitoring can lead to significant patient harm, often driven by inappropriate prescribing practices, which increase the risk of drug-drug interactions (DDIs). Although international initiatives such as the WHO's "Medication without Harm" aim to reduce medication-related harm by 50%, current strategies often overlook the specific challenges within the Malaysian healthcare context. This study aims to develop a structured framework to reduce inappropriate prescribing by identifying and mitigating DDIs in older diabetic patients in Malaysia. By integrating national clinical guidelines and drug interaction databases, the study conducts a hypothetical patient analysis to classify medications, detect potential conflicts, and propose optimized treatment plans. A decision analysis framework is utilized to evaluate and propose optimal medication regimens, minimizing adverse drug interactions and enhancing therapeutic outcomes. The ultimate objective is to support safer prescribing practices and enhance medication safety for elderly diabetic patients.

PARALLEL SESSION 2A

Deep Learning-Based Fusion of Multispectral and SAR Images for Cloud and Shadow Removal: A Comparative Study with Conventional Methods

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Abstract. Cloud and shadow contamination poses significant challenges in remote sensing image analysis, limiting the availability and reliability of optical satellite data. This study proposes a deep learning-based fusion framework to integrate multispectral (MS) and synthetic aperture radar (SAR) images, leveraging their complementary characteristics to mitigate cloud and shadow effects. The proposed model employs a deep neural network architecture specifically designed to learn spatial and spectral correspondences between MS and SAR modalities. To evaluate the quality of the fused images, eight fusion performance metrics, including Correlation Coefficient (CC), Universal Image Quality Index (UIQI), Relative Bias (Bias), Entropy (ENT), Root Mean Square Error (RMSE), Erreur Relative Globale Adimensionnelle de Synthèse (ERGAS), Structural Similarity Index (SSIM), and Difference in Variance (DIV), are utilized. Furthermore, the results are systematically compared against traditional image fusion methods, namely Brovey Transform, Gram-Schmidt Fusion, Intensity-Hue-Saturation (IHS) Transform, Principal Component Analysis (PCA), Nearest Neighbor Diffusion (NND), and Curvelet Transform Fusion. Experimental results demonstrate that the proposed deep learning-based fusion method outperforms conventional techniques in preserving spatial details, enhancing spectral consistency, and reducing cloud and shadow artifacts. The findings highlight the potential of deep learning approaches as a robust solution for enhancing the quality and usability of multispectral remote sensing data affected by atmospheric disturbances.

Keywords: Multispectral and SAR Fusion, Deep Learning, Cloud and Shadow Removal, Remote Sensing, Image Quality Assessment, Fusion Metrics

YOLOv7x and YOLOv8x: Efficiency on Rainfall Intensity Detection

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Abstract. In Malaysia, the rainfall intensity is monitored in real-time by MET Malaysia via the Mismos monitoring system, along with the other parameters that are the wind speed, wind direction, temperature, humidity, and pressure information. Nevertheless, the information on light, medium, or heavy rainfall is still manually calculated using the monitored data. Hence, this paper proposed a transfer learning-based approach, utilising YOLO models to detect rainfall intensity automatically. The performance of the two highly efficient YOLO models: YOLOv7x and YOLOv8x in detecting three classes of rainfall intensities under diverse environmental conditions is investigated. YOLOv7x and YOLOv8x models are the variants of the YOLO (You Only Look Once) model series that have contributed significant leap in object detection technology, offering advancements in speed, accuracy, and efficiency. Nevertheless, the rainfall intensity detection using these models has yet to be explored. Experimented on 1419 images, the results showed that both models performed well, but YOLOv8x model demonstrated superior performance with 98% precision, 99% recall. Moreover, the mAP values of the YOLOv8x are consistently higher than the YOLOv7x, indicating better performance across various IoU, which is essential for detecting rainfall under various imaging conditions.

Keywords: YOLOv7x, YOLOv8x, Precision, recall, Map.

Enhancing E-Invoice Automation with a Large Language Model (LLM) Integration through Whatsapp

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Abstract. This paper presents an automated system that generates e-invoices using a Large Language Model (LLM) integration through WhatsApp. The main objective of this study is to simplify the invoice creation process for small and medium enterprises (SMEs) by allowing users to submit invoice details through unstructured messages sent via WhatsApp. The system captures the message using the UltraMsg API and processes it through a Python-based Flask backend. OpenAI's GPT model is used to perform Natural Language Processing (NLP) to extract key invoice information. The extracted data is validated against predefined fields and formatted into a JSON structure that aligns with the invoice template, demonstrating high accuracy during testing across multiple scenarios with diverse sentence patterns and incomplete data. The generated invoice is a style of professional PDF file containing structured data with clear information, itemization, applied tax, discount, and total. It is generated using the ReportLab library in Python and includes invoice numbers and a timestamp for traceability. The generated invoice is then delivered back to the user as a WhatsApp document via a temporary public link hosted with Ngrok. A feature of the system is a chatbot that helps users answer questions as they complete the form.

Keywords: E-invoice, Large Language Model, WhatsApp, Natural Language Processing, Generative Pre-training Transformer.

A Geometric and Algebraic Framework for Quasi-Orthogonal Quantum Error Correction

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Abstract. Quantum computing offers significant computational advantages but remains limited by noise and decoherence. Quantum error correction (QEC) plays a central role in mitigating these challenges by encoding quantum information in ways that detect and correct errors. Traditional orthogonal codes provide strong error distinguishability but often incur high physical qubit overhead. In this work, we introduce a geometric and algebraic framework for constructing quasi-orthogonal quantum error-correcting codes, drawing on tools from finite field theory, orthogonal geometry, and group theory. Our approach enables the design of codes that retain essential error-distinguishing properties while relaxing strict orthogonality conditions. We propose a new family of quasi-orthogonal codes and investigate their performance under realistic noise models. While the framework is primarily theoretical, the results indicate that these codes can achieve reliable error correction with reduced resource requirements compared to fully orthogonal codes. This work contributes to the structural foundations of QEC and opens new directions for algebraically informed code design in near-term quantum systems.

Keywords: Quantum error correction, quasi-orthogonal codes, orthogonal geometry, group theory

PARALLEL SESSION 2B

Modeling and Forecasting Crude Oil Price Volatility Using GARCH Family Models

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Abstract. The GARCH (Generalised Autoregressive Conditional Heteroskedasticity) model is widely used to manage volatility. However, with many variations of the standard GARCH model, choosing the best one for predicting price fluctuations can be difficult. This study evaluates how different GARCH models perform in forecasting crude oil volatility using West Texas Intermediate (WTI) data. The models analysed include the standard GARCH, Integrated GARCH (IGARCH), Exponential GARCH (EGARCH), and Golsten, Jagannathan, and Runkle GARCH (GJR-GARCH), each with normal, Student's t, and Generalised Error Distribution (GED) distributions. To assess the model performance, criteria such as Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC), along with forecast accuracy metrics, absolute error, root mean squared error (RMSE), and mean absolute error (MAE), are used. Further, the post-estimation tests are conducted to ensure model validity. Findings show all models are suitable, with significant parameters and good post-estimation results. Notably, the EGARCH (1, 1) model with Student's t-distribution performs best in both data fit and time series forecasting.

Keywords: GARCH, model, forecasting, volatility, oil price

Evaluating Statistical and Machine Learning Models for River Flow Forecasting in Terengganu: A Case Study using Facebook Prophet, XGBoost and Random Forest

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Abstract. Accurate river flow forecasting is essential for flood mitigation and sustainable water resource management, especially in monsoon-prone areas like Terengganu, Malaysia. This study evaluates the forecasting performance of three models including Extreme Gradient Boosting (XGBoost), Facebook Prophet, and Random Forest using monthly river flow data from the Dungun and Kemaman Rivers (2001–2019). Results show that Random Forest consistently outperforms the other models, with the lowest RMSE and MAE at both locations. For the Kemaman River, it achieved up to 41.5% lower RMSE and 17.1% lower MAE than XGBoost while for the Dungun River, it showed a 16.45% reduction in RMSE and 16.17% in MAE. Facebook Prophet also performed well, particularly against XGBoost, with improvements of up to 39.1% in RMSE and 1% in MAE. Both Random Forest and Prophet demonstrate strong forecasting capabilities, attributed to their distinct but complementary approaches. Random Forest's ensemble-based structure offers robustness and accuracy in capturing peak flows and nonlinear patterns, while Facebook Prophet excels in modeling trends and seasonality in time series. These findings highlight the effectiveness of machine learning and statistical models in handling complex hydrological data and support their integration into regional flood forecasting and water resource planning systems.

Keywords: River flow, Extreme Gradient Boosting, Facebook Prophet, Random Forest

Securing the Road Ahead: Machine Learning Based Intrusion Detection System for Automotive Controller Area Network

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Abstract. Modern vehicles rely on Controller Area Network (CAN Bus) systems for internal communication, which makes them increasingly vulnerable to cyberattacks such as spoofing, flooding, fuzzing, and replay attacks. This study aims to develop a machine learning-based Intrusion Detection System (IDS) to detect and classify these attacks using a labeled multiclass CAN Bus dataset. Three classification models which are Random Forest (RF), K-Nearest Neighbors (KNN), and Artificial Neural Network (ANN) that were trained and evaluated using metrics such as accuracy, classification reports, confusion matrices and ROC-AUC scores. Among these, the Random Forest model achieved the highest accuracy of 99% demonstrating strong precision and recall across most attack types. The IDS was deployed via a Streamlit web to enhance its practical relevance.

Keywords: Controller Area Network (CAN Bus), Intrusion Detection System (IDS), Machine Learning (ML), Automotive Cybersecurity, Random Forest

Predictive Analytics for Reducing Perishable Inventory Waste in Food Supply Chains

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Abstract. Food supply chains often face challenges in managing perishable inventory due to short product lifespans, fluctuating demand, and limited storage capacity. Ineffective inventory management can lead to high levels of waste, operational inefficiency, and financial loss. This study proposes a predictive analytics framework to reduce perishable inventory waste by integrating demand forecasting, real-time monitoring, and machine learning models. Historical sales data and environmental conditions, such as temperature and humidity, are utilized to develop predictive models capable of estimating product shelf life and optimizing replenishment schedules. The framework is tested using a case study in a Malaysian food manufacturing and distribution context, where seasonal demand variability is a significant challenge. Preliminary results demonstrate that the predictive model can reduce inventory waste by up to 25% and improve order fulfillment rates by aligning replenishment decisions with predicted consumption patterns. The findings contribute to the development of intelligent food supply chains, supporting sustainability and cost efficiency.

Keywords: Perishable Inventory, Predictive Analytics, Machine Learning, Food Supply Chain, Waste Reduction

PARALLEL SESSION 3A

An Examination of AI-driven SQL Injection (SQLi) Attack Identification

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Abstract. In the rapidly evolving world of cybersecurity, SQL Injection (SQLi) attacks remain a serious concern. The estimated yearly global cost of these breaches is in excess of $4 billion. The persistence of SQLi assaults in exploiting defensive technology flaws has revealed shortcomings in the current dictation methods. 55% of organisations have experienced SQL injection assaults in the past year alone, according to latest figures. This demonstrates how urgently improved detection techniques are required. More specifically, one of the most frequent and dangerous threats to data security remains to be SQL assaults. The general cyber security problem is the widespread inability of traditional SQLi detection methods to adapt to the increasingly sophisticated techniques used by attackers. Many organizations, particularly small and medium enterprises (SMEs), struggle with traditional SQLi detection methods that fail to adapt to sophisticated attack techniques such as deep learning (DL) and machine learning (ML). While deep learning (DL) and machine learning (ML), two AI-driven technologies, show promise, they have not been thoroughly tested for effectiveness in a variety of real-world settings and environments. By evaluating the efficacy of AI-driven SQLi attack identification systems, contrasting their performance with conventional techniques, and offering insights into their real-world use, this study aims to close this gap. According to our research, AIdriven detection systems are able to identify SQLi attacks as accurately as 92% of the time. This is a notable improvement over traditional approaches, which usually report a precision level of roughly 75%.This study adds to the body of knowledge by outlining the efficacy of AI-driven solutions and providing a thorough analysis of their use in diverse organisational settings. The research offers potential recommendations for incorporating these cutting-edge systems into current security frameworks, enhancing overall defence against SQLi attacks.

Keywords: AI-driven SQL Injection, SQL Injector attacks, cybersecurity, SQL Injection Attack Identification, SQL Injector threats.

Moistify: A Modular AI-Integrated IoT Based Soil Moisture Monitoring and Decision Support System

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Abstract. The study proposes MOISTIFY, a modular Artificial Intelligence (AI) integrated Internet ofThings (IoT) solution to real-time soil moisture monitoring and decision support based on intelligent farming of rubber tree plantations. The system fulfills the unique needs inthe customary approaches to managing the soil moisture that is based on manual methods of inspection and cannot update the real time data and is labor intense. MOISTIFY combines ESP32 microcontroller, capacitive soil moisture sensors, and Firebase Realtime Database to deliver the constant monitoring of plantation zones. The smartphone app has moisture indicators with colors (R, G, B), indicators are red coloring (dry conditions: <20%); green coloring (optimal conditions: 21-40%); and blue (wet condition: >40%). The integration of Twilio API provides real-time SMS notifications when a measurement of moisture has exceeded safe levels. The system testing revealed a stable data transmission where ESP32 is able to send all data in every 60 seconds. Narbrough (FMS) Rubber Estate Ltd User Acceptance Testing confirmed that, the system was found to be, overall,very easy to use and understand. This modular scheme makes precision agriculture affordable to all rubber farmers in Malaysia because each unit will cost MYR 75.40 and is easy to scale up.

Keywords: IoT agriculture, soil moisture monitoring, decision support system, rubber plantation, precision farming, modular design

SMARTEX-AI: AI-Powered Remote Monitoring & Control System for Smart Latex Harvesting

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Abstract. Among modern agricultural engineering solutions, SMARTEX-AI: AI-Powered

Remote Monitoring & Control System for Smart Latex Harvesting (SMARTEX-AI) is one of the new technological interventions, which enhances the throughput as well as the purity of latex harvesting and acts against the negative impact of rainwater contamination on Dry Rubber Content (DRC). The project implementation was carried out in a specifically prototyping oriented approach. Using off-shelf Internet of Things (IoT) parts at a hardware level, the system consists of ESP32 microcontroller, custom-fabricated raindrop sensing module, a servo motor, and a relay sub-assembly. All these elements together take responsibility of opening or closing the latex cups to the dynamically changing climatic conditions. Naturally, the modular application of artificial intelligence (AI) to perform real-time data analysis, dynamically change decisions, and optimize control parameters is also integrated into the system. A mobile application designed and dedicated is given the opportunity to provide remote control to plantation managers including having a direct control over the individual cups and that the Adafruit IO web platform is provided with the possibility to use the Web-based control and issue remote commands. In order to provide a smooth connection between all hardware modules, the mobile application, and the cloud-based dashboard, the whole architecture is tied to the Message Queuing Telemetry Transport (MQTT) solution. Part of the methodological approach was that the design was developed iteratively where use-case and sequence diagrams were explicitly applied. Pragmatically, the solution has proved with the ability to boost productivity levels, maintain quality in the latex and give plantation stakeholders the freedom to monitor and intervene in the plantation at a distance. Since the modern technologies aimed at reducing the level of human interference in agricultural operations are inherently adaptive, it can be argued that the idea of constant upgrades of this platform by supplementing it with new-style sensor types, more efficient analytics chains, and better AI capabilities, should be promoted, as well, in order to maintain and enhance performance in the field.

Keywords: Smart Agriculture, Latex Harvesting, Internet of Things (IoT), Artificial Intelligence (AI), Remote Monitoring and Control, Dry Rubber Content (DRC), MQTT Protocol

Green Intelligence Unleashed: Cross-Industry Spectroscopy Platforms for Sustainable Data-Driven Decisions

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Abstract. Advanced analytical capabilities remain concentrated in expensive, centralized laboratories, creating significant access barriers for small and medium enterprises (SMEs), rural communities, and field researchers. Traditional near-infrared (NIR) spectroscopy systems cost RM20,000-RM200,000, require specialized expertise, and limit 95% of global locations from accessing real-time analytical support. This accessibility gap constrains innovation across healthcare, agriculture, food safety, and environmental monitoring sectors.This presentation introduces the integrated REVA+AINS platform, combining miniaturized portable spectroscopy hardware with cloud-based artificial intelligence for democratized analytical capabilities. REVA (Reagentless Blood Testing and Vital Signs Analyser) provides non-invasive, 3-second measurements of glucose, hemoglobin, and liquid sample parameters without consumables or waste generation. AINS (Artificial Intelligence for Near-Infrared Spectroscopy) enables rapid AI model development and deployment, reducing traditional spectroscopy model development from months to days while requiring no coding expertise.The platform eliminates traditional barriers through: (1) 99% cost reduction compared to conventional NIR systems, (2) zero-waste, reagent-free operation supporting sustainability goals, (3) simplified operation requiring no specialized training, (4) cloud-based AI enabling pay-per-use accessibility, and (5) cross-industry applications spanning biomedical, agricultural, food safety, and environmental monitoring sectors.Real-world applications demonstrate point-of-need analytical capabilities for rural healthcare (non-invasive glucose monitoring), precision agriculture (soil and crop analysis), food quality control (contamination detection), and environmental monitoring (water and air quality assessment). The platform enables immediate decision-making in resource-constrained environments while maintaining laboratory-grade accuracy.Academic researchers gain accelerated spectroscopy research capabilities with 10x productivity improvement in model development. Industry professionals' access affordable entry points for analytical technology adoption. Both sectors benefit from collaborative opportunities through beta testing programs and partnership initiatives that advance sustainable analytical innovation.Attendees will understand how miniaturized spectroscopy combined with cloud AI can eliminate traditional analytical barriers, explore collaboration opportunities for their specific research or industry applications, and gain insights into the future of accessible, sustainable analytical technology deployment.

FPGA-Accelerated Neuromorphic Computing for Real-time Signal Processing in Optical Fiber Biosensor Devices: A System Architecture

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Abstract. This paper presents a system architecture for a portable leptospirosis detection systems, with an emphasis on developed Digital Signal Processing (DSP) framework embedded into Reconfigurable Architecture for Neuromorphic Computing (RANC) implemented on a Field Programmable Gate Array (FPGA) platform. The proposed system addresses the limitations of conventional detection approaches, such as low sensitivity, high cost, and the need for skilled expertise and specialised infrastructure, through the utilisation of tapered optical fiber biosensor. The DSP framework encompasses critical steps, including Z-standardisation, baseline correction, Chebyshev Type II filter for signal preprocessing, and spectral feature extraction to isolate signals of interest, followed by a trained Machine Learning (ML) model implementation for a better and accurate data prediction. Two ML models, Support Vector Machine (SVM) and Random Forest (RF), were evaluated for classification. The results revealed that signal preprocessing produces clearer spectral signals and improves signal clarity. Besides, a trained SVM model demonstrated outstanding performance, achieving an accuracy of 0.95 and precision of 0.96, which resulted in a rapid and better detection of Leptospira bacteria. Therefore, the integrated DSP framework enhances signal clarity, improves the detection system's reliability, and enables rapid and accurate real-time detection. Keywords: Digital Signal Processing, Machine Learning, FPGA, Neuromorphic Computing, Optical Fiber Biosensor.

PARALLEL SESSION 3B

Multivariate Analysis using Maximum Likelihood and Partial Least Squares Technique in Model Estimation: Robustness of Parameter Estimates

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Abstract. Multivariate technique has been around to help researchers understand and interpret the complex world. The technique has also been introduced with various statistical estimation techniques which among others depend on the research model complexity, types of reasoning either deductive or inductive, the distributional assumptions of the dataset, and many more. It is hypothesised that despite the various available techniques and assumptions that have to be met, the research model to be tested should be robust in terms of its parameter estimates so as to understand and interpret the world better. Therefore, this paper examined the stability of the parameter estimates for a research model by taking into account the prerequisites and requirements for both estimation techniques i.e. maximum likelihood and partial least squares. Through this study, we can conclude whether the research model which has been tested is robust to any estimation techniques or correctly conceptualized with the real-world. In conclusions, various estimation techniques used in multivariate analysis should follow all the fundamentals principles of those techniques.

Keywords: multivariate technique, maximum likelihood, partial least squares, deductive reasoning, inductive reasoning

Smart SPC in Excel: Real-Time Quality Monitoring for Smarter Manufacturing

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Abstract. This study presents a Smart Statistical Process Control (SPC) system using Microsoft Excel to enable real-time quality monitoring in manufacturing environments. Traditional SPC methods, including manual inspections and verifications, are prone to inaccuracies due to human error and environmental factors. To address these limitations, the proposed system automates the detection of process deviations and abnormalities using the $\bar{X} - R$ control chart, based on established out-of-control rules such as Rule 117777. The objectives include monitoring product performance, automatically identifying abnormal variations, and visualizing quality trends through an interactive Excel-based dashboard. The methodology involves data collection, preprocessing, and statistical analysis to evaluate process stability. Results show that the smart SPC system improves the effectiveness of Six Sigma practices by enhancing accuracy, reducing quality control costs, and supporting timely, data-driven decisions. The customizable dashboard further supports operational efficiency and is adaptable across various manufacturing sectors to improve product quality and customer satisfaction.

Keywords: Statistical Process Control, Six Sigma, Manufacturing Quality

A Fully Integrated Pipeline from Training to Real-Time Visualization for Industrial Defect Detection

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Abstract. In the Industry 4.0 era, semiconductor fabrication demands unparalleled precision and robust automation, yet conventional inspection workflows often struggle with optical distortions, variable surface reflectivity, and process-induced noise—allowing submicron defects to evade detection and compromise yield and reliability. Mi-VisionAOI addresses these challenges through a fully integrated pipeline that seamlessly integrates with existing factory cameras, eliminating the need for additional hardware. It delivers real-time image enhancement— including denoising, contrast optimization, and geometric correction—alongside intuitive annotation tools for bounding boxes, polygons, pixel-level masks, oriented bounding boxes, and contour editing. The platform then automates model training for object detection, semantic segmentation, OBB localization, and unsupervised anomaly detection, complete with built-in data augmentation and hyperparameter optimization. An inference engine executes these models, while the visualization module overlays defect markers onto standard Vision streams and provides configurable dashboards and alerts. By offering end-to-end functionality from raw image acquisition to live monitoring, Mi-VisionAOI empowers manufacturers to identify, classify, and address defects with precision and efficiency, ensuring consistent product quality and operational reliability.

Spectral Data and AI Revolutionize Agricultural Decision-Making

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Abstract. The interaction of energy across various electromagnetic wavelengths, such as visible and infrared, produces unique spectra through absorption, reflection, and scattering. These spectra provide valuable insights into the biochemical and structural properties of matter. By integrating artificial intelligence (AI) with this spectral data, AI empowers the data to identify patterns and make highly accurate predictions, such as crop ripeness, health, and yield estimation. This AI-driven approach transforms raw spectral data into actionable insights, optimizing agricultural practices, improving resource use, and enabling smarter decision-making in real time.

Development of an Autonomous Mobile Robot Platform to Boost the Oil Palm Industry and Support Multi-Sector Deployment

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Abstract. Malaysia's oil palm sector plays a vital role in the nation's economy but continues to face long-standing challenges including labour shortages, operational inefficiencies, and limited access to digital solutions among smallholders. This project introduces an autonomous mobile robot platform tailored to boost productivity, reduce costs, and improve sustainability in plantation operations. Equipped with GPS-RTK for precision navigation, multisensory integration, AI-driven task control, and modular payload capabilities, the robot supports key agricultural tasks such as fertilizing and spraying. Beyond agriculture, the platform is designed for multi-sector adaptability. Its rugged design and intelligent control systems enable deployment in border patrol, construction sites, and search and rescue (SARS) operations in difficult terrains. This versatility ensures scalability and long-term value, making it a strategic asset for Malaysia's transition toward automation and smart infrastructure. The innovation promotes not only agricultural resilience but cross-industry technological empowerment.