NEWSLETTER

e-SCIENCE PUTRA

AGRICULTURE | INNOVATION | LIFE

ISSUES 21 (MAY - AUGUST 2026)

Welcome to the Newsletter e-Science Putra. This issue presents the research activities from May to August 2026 which highlight the latest research findings by the selected faculty members.

HIGHLIGHTS

- A Greener Approach to Palm Oil Purification: K_2O/Dolomite Adsorbent for Fatty Acid Removal
- The Quantum Leap: How Machine Learning Is Re-Inventing Superconductor Discovery
- Cardiac MR Phantom as a Bridge to Reliable Myocardial T1 Measurement
- Robust Modeling of Extreme Wind Speeds in Japan under Present and Future Climate Conditions

A GREENER APPROACH TO PALM OIL PURIFICATION: K_2O/DOLOMITE ADSORBENT FOR FATTY ACID REMOVAL

Prof. ChM Dr. Irmawati Ramli
Department of Chemistry, Faculty of Science, Universiti Putra Malaysia
Expertise: Catalysis
Email: irma@upm.edu.my

Malaysia produces approximately 24,000 tonnes of crude palm oil (CPO) annually, but its quality is strongly affected by free fatty acid (FFA) content, a key indicator of deterioration that must remain below 5% to meet industry standards. High FFA levels impair flavour and generate harmful oxygenated compounds. Although conventional chemical refining is effective, it produces excessive wastewater and soap stock. This study introduces potassium oxide–supported dolomite (K_2O/dolomite) as a cleaner, adsorption-based alternative, offering lower oil loss, minimal contamination, and straightforward filtration-based separation. Characterisation confirmed that K_2O loading enlarges pore size and substantially increases basic site density, rising from 501.4 to 3,165.2 µmol/g, enhancing thermal stability, surface basicity, and porosity for stronger FFA binding. XRD analysis further confirmed these structural changes upon K_2O incorporation, as shown in Figure 1.

The Taguchi method was used to optimise four process parameters: contact time, stirring rate, adsorbent dosage, and K_2O concentration. Signal-to-noise ratio (SNR) analysis identified K_2O concentration (67%) and adsorbent dosage (27%) as the dominant factors influencing FFA removal, as shown in Figure 2, while stirring rate and contact time had negligible influence (< 5%). ANOVA confirmed both as statistically significant (Prob > F < 0.05). Under optimised conditions of 30 min, 700 rpm, 5 wt% adsorbent dosage, and 15 wt% K_2O, the adsorbent achieved a maximum FFA reduction of 63%. These results position K_2O/dolomite as a scalable, energy-efficient adsorbent with strong potential for industrial palm oil refining applications.

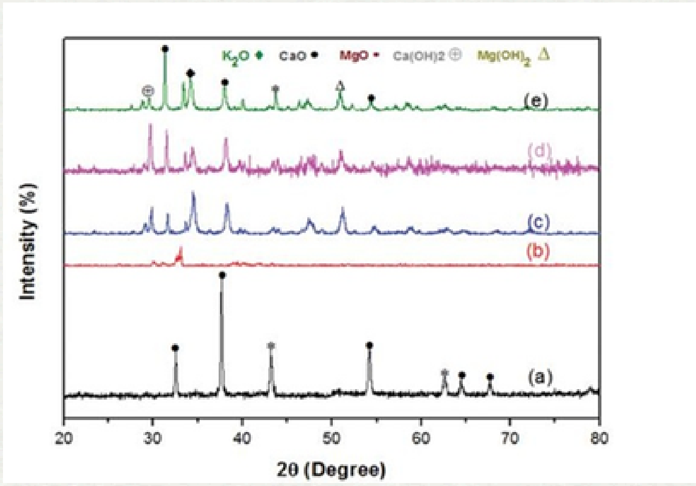


Figure 1: XRD profiles of calcined dolomite (a), K_2O (b), and K_2O/dolomite adsorbents at 5 wt% (c), 10 wt% (d), and 15 wt% (e) K_2O loading.

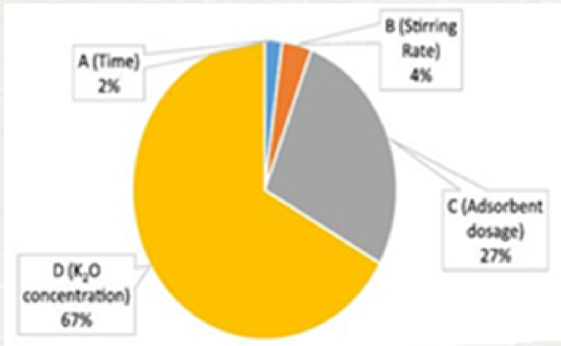


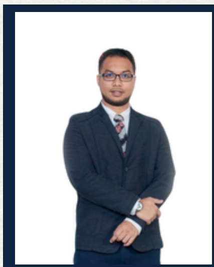
Figure 2: Percentage contribution of each process parameter towards FFA adsorption activity, as determined by the Taguchi method.

References

[1] Nor Shafizah, I., Irmawati, R., Hishamuddin, O., Yahaya, M., & Alia Aina, A. (2022). Removal of free fatty acid (FFA) in crude palm oil (CPO) using potassium oxide/dolomite as an adsorbent: Optimization by Taguchi method. Food Chemistry, 373, 131668.
[2] Yahaya, M., Irmawati, R., Muhamad, E. N., Ishak, N. S., Nda-Umar, U. I., & Taufiq-Yap, Y. H. (2020). K_2O doped dolomite as heterogeneous catalyst for fatty acid methyl ester production from palm oil. Catalysts, 10(7), 1–17.
[3] Singh, T. S., & Verma, T. N. (2019). Taguchi design approach for extraction of methyl ester from waste cooking oil. Energy Conversion and Management, 182, 383–397.

NEWSLETTER
e-SCIENCE PUTRA
AGRICULTURE | INNOVATION | LIFE
ISSUES 21 (MAY - AUGUST 2026)

THE QUANTUM LEAP: HOW MACHINE LEARNING IS RE-INVENTING SUPERCONDUCTOR DISCOVERY



Dr. Muhammad Kashfi Shabdin
Department of Physics, Faculty of Science,
Universiti Putra Malaysia
Expertise: Magnetorheological Materials,
Sensing Technology
Email: kashfi.shabdin@upm.edu.my

Superconductors — materials capable of conducting electricity with absolutely zero energy loss — hold the key to a revolutionary future, from ultra-fast levitating trains to highly efficient medical MRI scanners. Historically, finding and refining these extraordinary materials has been a painfully slow and expensive process of trial-and-error, where scientists spent decades testing combinations by hand with a success rate of only around three percent. Today, a powerful shift is taking place as researchers combine traditional laboratory experiments with artificial intelligence (AI) and machine learning. Instead of guessing blindly, scientists can now feed vast chemical databases into smart algorithms that recognize hidden microscopic patterns. This data – driven approach acts like a digital compass, narrowing down millions of hypothetical material candidates into a handful of promising options, successfully compressing discovery timelines from decades into mere months.

The true brilliance of this modern AI integration lies in its ability to masterfully optimize how superconductors are manufactured. Using an advanced mathematical strategy called Bayesian Optimization, the machine learning system coordinates an interactive loop between computational software and real-world laboratory tests. The algorithm systematically analyses previous experiment results and precisely calculates the absolute best temperatures and chemical ratios needed for the next attempt. This eliminates human bias and prevents researchers from getting trapped in narrow, conventional routines. The immense power of this collaborative workflow was recently proven when scientists successfully synthesized record- breaking magnets that are over two and a half times stronger than previous versions, while requiring only a fraction of the usual experimental trials. By balancing exploratory guesswork with highly focused tuning, machine learning is rapidly accelerating our global journey toward the ultimate scientific holy grail: practical room-temperature superconductivity.

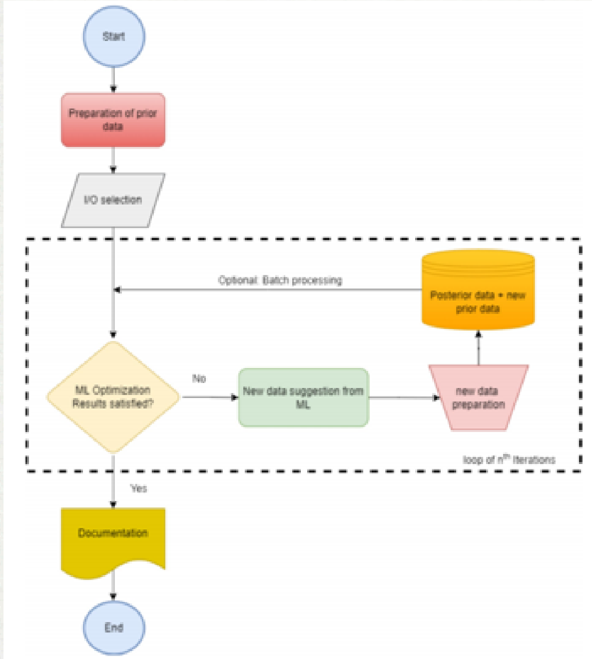


Figure 1. Basic structure for data – driven experiment [1].

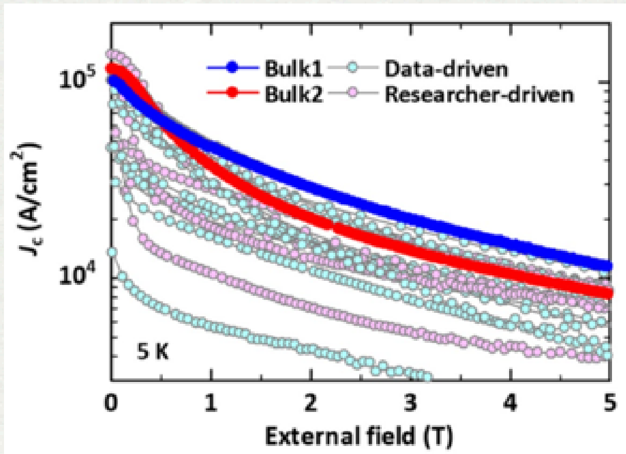


Figure 2: The comparison between the critical current density (J_c) in external field between bulk superconductor 1, bulk superconductor 2, data - driven experiment, and researcher - driven experiment [2].

References

[[1] M. K. Shabdin, M. Miryala, M. M. A. Kechik, C. S. Kien, L. K. Pah, and M. A. Azam, "Data-Driven Superconductivity: a Review of Machine Learning Methods for Material Discovery, Property Prediction, and Process Optimization," Jun. 01, 2026, Springer.

[2] A. Yamamoto, S. Tokuta, A. Ishii, A. Yamanaka, Y. Shimada, and M. D. Ainslie, "Superstrength permanent magnets with iron-based superconductors by data- and researcher-driven process design," NPG Asia Mater., vol. 16, no. 1, Dec. 2024.

NEWSLETTER
e-SCIENCE PUTRA
AGRICULTURE | INNOVATION | LIFE
ISSUES 21 (MAY - AUGUST 2026)

CARDIAC MR PHANTOM AS A BRIDGE TO RELIABLE MYOCARDIAL T1 MEASUREMENT

Prof. Madya Dr. Muhammad Khalis Abdul Karim
Department of Physics,
Faculty of Science,
Universiti Putra Malaysia
Expertise: Medical Physics, Medical Imaging, Radiation Physics and Radiobiology
Email: mkhalis@upm.edu.my

Quantitative cardiac magnetic resonance imaging (MRI) has substantially advanced the non-invasive characterisation of the myocardium, enabling tissue assessment without contrast administration or endomyocardial biopsy. Central to this development is T1 mapping, which quantifies the longitudinal (T1) relaxation time of myocardial tissue, a parameter that varies with fibrosis, oedema, iron overload and amyloid infiltration. In conjunction with the derived extracellular volume (ECV) fraction, T1 mapping now supports the diagnosis and longitudinal monitoring of conditions such as cardiomyopathy, myocarditis and cardiac amyloidosis. Nevertheless, the clinical utility of quantitative mapping is constrained by measurement variability. The most widely adopted acquisition sequences, notably MOLLI and ShMOLLI, systematically underestimate T1 owing to T2 and magnetisation-transfer effects, and reported values differ across scanner vendors, field strengths and software versions (Piechnik et al., 2010). In the absence of a common reference standard, T1 values acquired on one system cannot be reliably compared with those from another, thereby undermining multicentre clinical trials and long-term patient follow-up.

The cardiac MR phantom addresses this limitation directly. A phantom (Figure 1) is a physical object of known and stable composition, typically vials of nickel-chloride-doped agarose gel tuned to reproduce the T1 and T2 relaxation values of myocardium (approximately 950–1050 ms at 1.5 Tesla (T) and 1150–1250 ms at 3 T) and blood, which provides a ground-truth reference free from biological variability. Scanned alongside patients, it enables individual sites to derive correction factors that harmonise T1 measurements across vendor platforms (Siemens, GE and Philips) and to validate emerging sequences prior to clinical deployment (Figure 2).

Phantom design is critical. The gel must remain stable throughout its shelf life, and because the T1 of aqueous solutions shifts by approximately 1–2 % per degree Celsius, temperature must be controlled or corrected. Current work examines how standardised phantoms can be integrated into routine clinical workflows without prolonging patient scan time, and extends to emerging frontiers including MR fingerprinting and validation at ultra-high (5 T) and low (0.55 T) field strengths (Si et al., 2024), together with deep-learning approaches to noise reduction in T1 mapping. Hence, the phantom constitutes the bridge between what a sequence measures and what a clinician can trust, and thus the cornerstone of reproducible, standardised cardiac MRI.

Figure 1: Cardiac T1 phantom ($NiCl_2$-doped agarose vials) used as a reference standard.

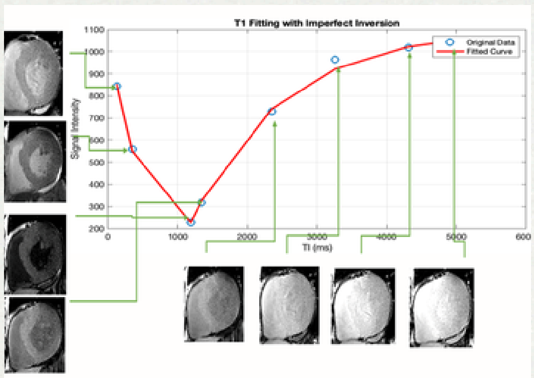


Figure 2. Representative myocardial T1 map acquired for phantom-based validation.

References

1. Piechnik SK, Ferreira VM, Dall'Armellina E, et al. (2010). Shortened Modified Look-Locker Inversion recovery (ShMOLLI) for clinical myocardial T1-mapping at 1.5 and 3 T within a 9-heartbeat breathhold. Journal of Cardiovascular Magnetic Resonance, 12(1), 69.

2. Si D, Crabb MG, Kunze KP, Littlewood SJ, Prieto C, Botnar RM. (2024). Free-breathing 3D whole-heart joint T1/T2 mapping and water/fat imaging at 0.55 T. Magnetic Resonance in Medicine, 92(4), 1511–1524.

3. Sawamura S, Kato S, Yasuda N, Iwahashi T, Hirano T, Kato T, Utsunomiya D. (2025). Evaluating a second-generation deep learning technique for noise reduction in myocardial T1-mapping magnetic resonance imaging. Diseases, 13(5), 157.

NEWSLETTER
e-SCIENCE PUTRA
AGRICULTURE | INNOVATION | LIFE
ISSUES 21 (MAY - AUGUST 2026)

ROBUST MODELING OF EXTREME WIND SPEEDS IN JAPAN UNDER PRESENT AND FUTURE CLIMATE CONDITIONS

Dr. Muhammad Aslam Mohd Safari
Department of Mathematics and Statistics,
Faculty of Science,
Universiti Putra Malaysia
Expertise: Applied Statistical Modeling, Statistical Simulation
Email: aslam.safari@upm.edu.my

Extreme wind events are becoming an increasingly important concern because very high wind speeds can cause major damage to buildings, transport systems, and other critical infrastructure. However, modeling such extremes is statistically challenging because unusually large values may strongly affect parameter estimation if they are not handled carefully. To address this issue, this study proposes a robust estimation method, called the probability integral transform estimator (PITE), for the generalized extreme value (GEV) distribution. The overall research workflow is summarized in Fig. 1, starting from daily maximum wind speed data from the d4PDF large-ensemble climate simulations, followed by block maxima extraction, GEV fitting, model checking, and return level estimation. The GEV model is widely used in extreme value analysis [1], while the d4PDF dataset provides a valuable resource for studying present and future climate risks over Japan [2]. The proposed PITE method was developed to reduce the influence of atypical observations while still preserving the contribution of genuine extreme events, making it a practical and reliable tool for environmental applications [3].

The method was then applied to daily maximum 10 m wind speed data at 311 grid points across Japan under both present and future climate conditions. The main findings are presented in Fig. 2, where Fig. 2(a) shows the estimated return levels for present and future climates, and Fig. 2(b) shows the ratio of future-to-present return levels. The results indicate clear regional differences, with generally higher extreme wind levels in southern, coastal, and island regions. They also show that future changes are more pronounced for longer return periods, with the 50-year and 100-year return levels increasing on average, suggesting a heavier upper tail of the wind distribution under future warming. This means that rare but high-impact wind events may become more severe in the future. Such findings are important for hazard mitigation, infrastructure planning, and long-term climate resilience [2]. They also support the need to consider future climate risk when evaluating design standards and protection strategies for exposed areas [3].

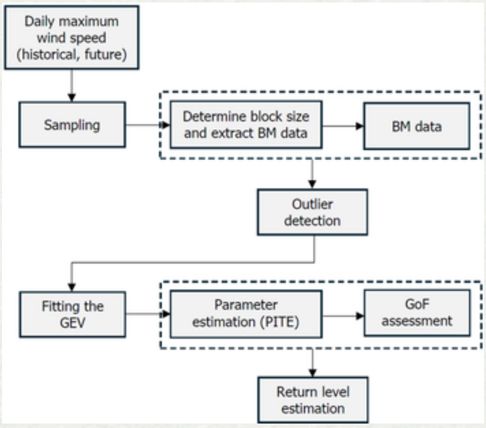


Fig. 1. Workflow of the extreme wind analysis in Japan.

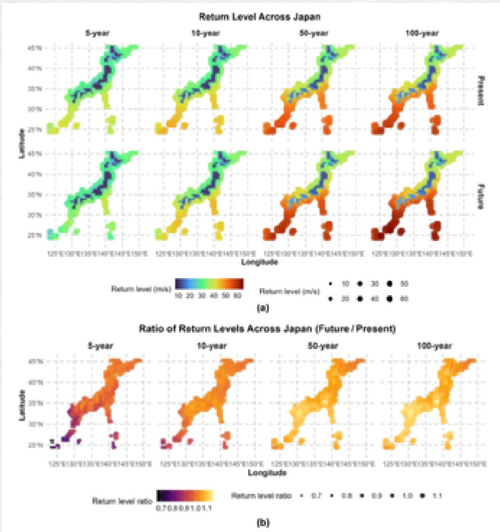


Fig. 2. (a) Return levels under present and future climates; (b) future-to-present return level ratio.

References:

[1] Coles S (2001) An introduction to statistical modeling of extreme values. Springer Series in Statistics, Springer, London.

[2] Mizuta, R., Murata, A., Ishii, M., Shiogama, H., Hibino, K., Mori, N., ... & Kimoto, M. (2017). Over 5,000 years of ensemble future climate simulations by 60-km global and 20-km regional atmospheric models. Bulletin of the American Meteorological Society, 98(7), 1383-1398.

[3] Safari, M. A. M., Nakaegawa, T., & Masseran, N. (2026). Robust fitting of generalized extreme value distribution for extreme wind speeds: a case study using d4PDF data in Japan. Environmental and Ecological Statistics, 1-30.

Science is much more than just a body of KNOWLEDGE.
It is a way of THINKING.

eISSN 2805-4512

FACULTY OF SCIENCE, UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR DARUL EHSAN, MALAYSIA
+603 97696601/6602/6603 www.science.upm.edu.my fs_tdps@upm.edu.my