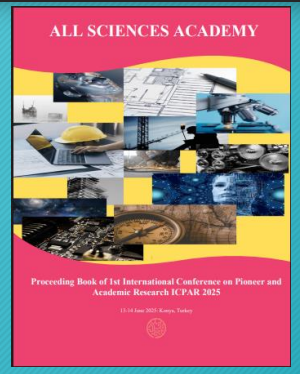
Akın İlhan

Adaptive Neuro Fuzzy Inference System Predictions on Energy Generations and Waste-water Properties of a Treatment Plant



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Adaptive Neuro Fuzzy Inference System Predictions on Energy Generations and Waste-water Properties of a Treatment Plant

Akin Ilhan*

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Abstract – In this study, energy production of gas turbines as well as the physical and chemical properties of the waste-water of an installed waste-water treatment plant have been forecasted, using the method of adaptive neuro fuzzy inference system. Accordingly, in total, 445 data were used to be the cumulative; to include the instantaneous measurements belonging to these parameters. Namely, these data correspond to daily mean energy generation (P) acquired from gas turbines of the treatment plant plus correspond to physical and chemical parameters consisting of the degree of acidity (pH), temperature (T), conductivity (σ), and the daily cumulative gas production (Q) for the gas generator. It was concluded and reported that the best estimation outcome for power production (P) was acquired during the adjustment of the adaptive neuro fuzzy inference system to have the value of the membership-function to correspond to 2, resulting the values of mean absolute error (MAE), root mean square error (RMSE), besides correlation coefficient (R) to respectively counterpart 2.1814 MWh/day, 2.7619 MWh/day, and 0.9610.

Sıtkı Kocaoğlu

FPGA implementation of deep learning architecture for ankylosing spondylitis detection from MRI

Published in *Scientific Reports*, *July 2025*

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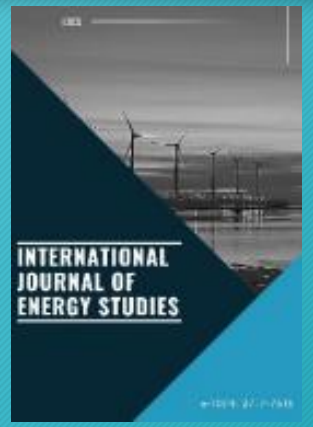
FPGA implementation of deep learning architecture for ankylosing spondylitis detection from MRI

Sıtkı Kocaoğlu

Ankylosing Spondylitis (AS), commonly known as Bechterew's disease, is a complex, potentially disabling disease that develops slowly over time and progresses to radiographic sacroiliitis. The etiology of this disease is poorly understood, making it difficult to diagnose. Therefore, treatment is also delayed. This study aims to diagnose AS with an automated system that classifies axial magnetic resonance imaging (MRI) sequences of AS patients. Recently, the application of deep learning neural networks (DLNNs) for MRI classification has become widespread. The implementation of this process on computer-independent end devices is advantageous due to its high computational power and low latency requirements. In this research, an MRI dataset containing images from 527 individuals was used. A deep learning architecture on a Field Programmable Gate Array (FPGA) card was implemented and analyzed. The results show that the classification performed on FPGA in AS diagnosis yields successful results close to the classification performed on CPU.

Mehmet Zahid Erel

A high-efficiency hybrid energy system composed of fuel cell and thermoelectric generator for light electric vehicles



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A high-efficiency hybrid energy system composed of fuel cell and thermoelectric generator for light electric vehicles

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Highlights

- A hybrid energy system combining a fuel cell (FC) and thermoelectric generator (TEG) is proposed to enhance efficiency through waste heat recovery without requiring additional fuel input
- The proposed system offers a cost-effective and lightweight solution for sustainable transportation technologies
- The Perturb and Observe (P&O) MPPT-based SEPIC converter is employed to ensure optimal power extraction from the FC, offering buck–boost functionality suitable for light electric vehicle (EV) applications.

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ABSTRACT

This study proposes a more effective utilization of fuel cell (FC) technology by integrating a thermoelectric generator (TEG), which harnesses waste heat to generate electrical energy. While the FC still requires hydrogen, the integration of a TEG enables supplementary power generation from waste heat without any additional fuel input, resulting in a more efficient and compact hybrid system. The Perturb and Observe (P&O) MPPT-based SEPIC converter is highlighted for use in light fuel cell electric vehicle (FCEV) applications due to its inherent buck–boost capability, making it particularly suitable for practical implementations. To achieve maximum efficiency and ensure stable operation of the TEG, the FC is operated at its nominal power of 93.75 W in this system. The integrated TEG system, combined with a high-efficiency boost converter, contributes approximately 5-W to the proposed hybrid energy system, which achieves an overall efficiency of 96.1%. The proposed hybrid energy system holds great potential for providing sustainable energy solutions in transportation applications.

Ahmed Alhayek, Mehmet Akif Ozdemir, ***Mehmet Zahid Erel***, Mehmet Timur Aydemir

A Modified Plate Design for Capacitive Wireless Power Transfer Systems

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Recent study by

Asst. Prof. Dr. Mehmet Zahid Erel
Energy Systems Engineering

A Modified Plate Design for Capacitive Wireless Power Transfer Systems

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***Abstract*—The share of capacitive wireless power transfer in recent wireless power transfer research has been increasing. The advantage of these systems mainly comes from their simple structures. The power is transferred between the plates, and there is no need for magnetic shielding as there is no magnetic field involved. The transferred energy depends on the capacitance of the plates, and increasing the effective area of the plate without changing its size can be effective. This paper proposes a simple technique to increase the effective area of plates. Basically, the effective area is increased by grooving the surface, like the fins of heat sinks. The proposed technique has been tested on a four-plate horizontal structure. The results show that the proposed method can be effective.**

***Index Terms*—Capacitive wireless power transfer, Plate design structure.**

12 June - 25 July '25

Musaria Karim Mahmood, Ali Rachini
Most Cited AI Research (2024-2025): A Cross-Sector Review

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Research Article

Most Cited AI Research (2024–2025): A Cross-Sector Review

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ABSTRACT

The blistering pace of generative and foundational AI models being deployed in 2024 and 2025 is transforming experiences in education, healthcare, science, sustainability and business. This narrative review consolidates findings from the 50 most cited peer reviewed publications in this time frame, providing a cross-cutting overview on the state of development, the application and the challenges concerning technology. We start by discussing the architectural origins behind both large language models, multimodal generators, as well as domain-specific foundation models including SpectralGPT and scGPT. Then, we evaluate their application on vertical-industrial applications of academic teaching, clinical diagnosis, supply chain operation, and environmental monitoring. The review discusses also important ethical and societal issues, including fairness, explainability, AI angst, and academic responsibility. We also discuss lingering technical challenges including hallucination, data privacy, and availability barriers despite recent progress made. Finally, we discuss some of the emerging frontiers that this work opens and their exciting implications, including controllable generation, symbolic-neural integration, and divergence between open and proprietary model ecosystems. This citation-motivated review provides a timely snapshot of how the most influential research is leading the development of generative AI across domains.

Marshima Mohd Rosli, Ali Rachini, ***Musaria Karim Mahmood***

Data-Driven Melt Pool Monitoring and Defect Prediction in LPBF of Ti-6Al-4V Alloy

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Research Article

Data-Driven Melt Pool Monitoring and Defect Prediction in LPBF of Ti-6Al-4V Alloy

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ABSTRACT

Real-time process monitoring is essential for achieving consistent part quality in Laser Powder Bed Fusion (LPBF), yet robust and practical defect prediction frameworks remain underdeveloped. This study presents a machine learning-based approach for predicting unstable melt pool conditions, leveraging an open dataset of melt pool variability measurements from Ti-6Al-4V builds on an EOS M290 system. The framework utilizes fundamental process parameters—laser velocity, power, scan orientation, and track location—combined with statistical melt pool geometry features to train a Random Forest classifier. The model achieved an accuracy of 99.79% in distinguishing between stable and unstable melt pool states, with balanced sensitivity and specificity. Analysis of defect trends across the process parameter space revealed that higher scan velocities and certain orientations significantly increase defect likelihood. The results confirm that interpretable, computationally efficient machine learning models can provide robust real-time defect prediction using features already accessible on commercial LPBF platforms. The framework offers a scalable and industry-relevant pathway toward enhanced quality assurance in metal additive manufacturing, supporting the advancement of intelligent, closed-loop LPBF process control.

12 June - 25 July '25

Raed Abdulkareem Hasan, Mahmod A Abdulqader, Azil Bahari Alias, Noor A Hussein, Omer Khalil Ahmed, Jafar Keighobadi, Ali Mohammed Saleh, Zeyad K Hamad, Noah Mohammed Saleh, ***Musaria Karim Mahmood***

Advancements and Performance of Evaporative Cooling Technologies: Applications, Benefits, and Future Prospects

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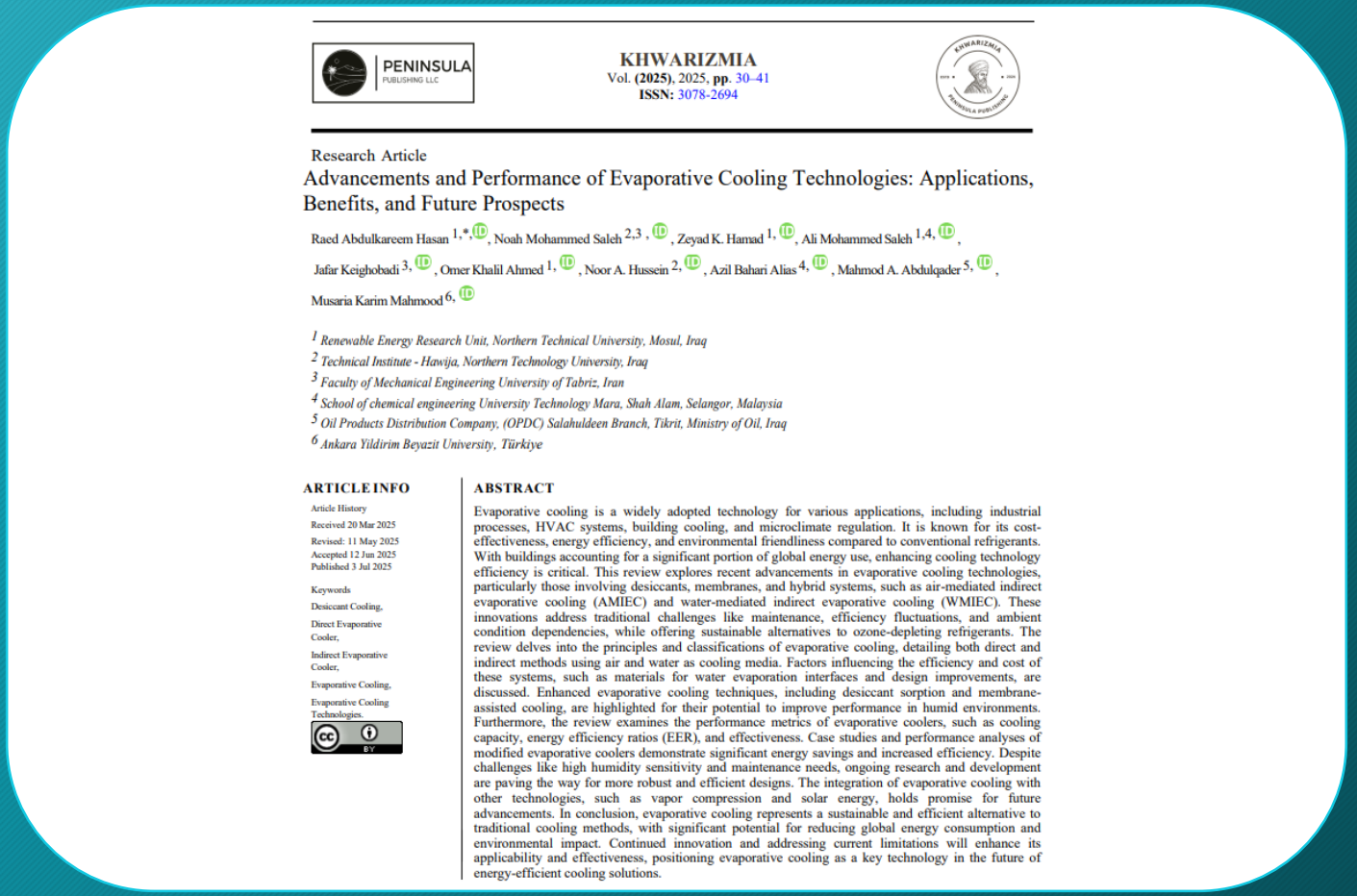

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Research Article

Advancements and Performance of Evaporative Cooling Technologies: Applications, Benefits, and Future Prospects

Raed Abdulkareem Hasan [1,*], Noah Mohammed Saleh [2,3], Zeyad K. Hamad [1], Ali Mohammed Saleh [1,4], Jafar Keighobadi [3], Omer Khalil Ahmed [1], Noor A. Hussein [2], Azil Bahari Alias [4], Mahmod A. Abdulqader [5], Musaria Karim Mahmood [6]

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ABSTRACT

Evaporative cooling is a widely adopted technology for various applications, including industrial processes, HVAC systems, building cooling, and microclimate regulation. It is known for its cost-effectiveness, energy efficiency, and environmental friendliness compared to conventional refrigerants. With buildings accounting for a significant portion of global energy use, enhancing cooling technology efficiency is critical. This review explores recent advancements in evaporative cooling technologies, particularly those involving desiccants, membranes, and hybrid systems, such as air-mediated indirect evaporative cooling (AMIEC) and water-mediated indirect evaporative cooling (WMIEC). These innovations address traditional challenges like maintenance, efficiency fluctuations, and ambient condition dependencies, while offering sustainable alternatives to ozone-depleting refrigerants. The review delves into the principles and classifications of evaporative cooling, detailing both direct and indirect methods using air and water as cooling media. Factors influencing the efficiency and cost of these systems, such as materials for water evaporation interfaces and design improvements, are discussed. Enhanced evaporative cooling techniques, including desiccant sorption and membrane-assisted cooling, are highlighted for their potential to improve performance in humid environments. Furthermore, the review examines the performance metrics of evaporative coolers, such as cooling capacity, energy efficiency ratios (EER), and effectiveness. Case studies and performance analyses of modified evaporative coolers demonstrate significant energy savings and increased efficiency. Despite challenges like high humidity sensitivity and maintenance needs, ongoing research and development are paving the way for more robust and efficient designs. The integration of evaporative cooling with other technologies, such as vapor compression and solar energy, holds promise for future advancements. In conclusion, evaporative cooling represents a sustainable and efficient alternative to traditional cooling methods, with significant potential for reducing global energy consumption and environmental impact. Continued innovation and addressing current limitations will enhance its applicability and effectiveness, positioning evaporative cooling as a key technology in the future of energy-efficient cooling solutions.