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EDITORIAL

Introduction to the Special Issue on Applied Artificial Intelligence: Advanced Solutions for Engineering Real-World Challenges

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This special issue, entitled *"Applied Artificial Intelligence: Advanced Solutions for Engineering Real-World Challenges"*, was established to highlight the practical and emerging impact of AI in addressing challenging engineering problems [1–5]. The published contributions demonstrate that AI is no longer limited to theoretical investigation but is increasingly serving as a deployment-oriented tool for solving problems in infrastructure monitoring, renewable energy prediction, robotic interaction, communication systems, image reconstruction, cybersecurity, and intelligent power management. Collectively, the accepted papers show how advanced AI methodologies can be adapted to diverse engineering contexts while maintaining strong relevance to practical applications.

A prominent group of papers in this special issue addresses civil and structural engineering, computer vision, and intelligent monitoring. Jin et al. [6] developed a crack-detection framework for bridge structural health monitoring by combining a convolutional neural network (CNN) for local detail extraction with a transformer-based attention mechanism for global context modelling. Their proposed feature fusion strategy improves robustness under noise, variable illumination, and other challenging field conditions, contributing to automated infrastructure inspection. In a related vision-oriented direction, Hamplová et al. [7] investigated the effect of a normalised structural similarity index measure (SSIM) loss in super-resolution tasks, demonstrating that improved loss design can enhance structural fidelity and visual quality in reconstructed images. These studies illustrate the growing role of AI in intelligent visual analysis and image-based engineering diagnostics.

Another important theme of the issue is energy engineering, power systems, and forecasting under complex operating conditions. Chen et al. [8] proposed a decomposition–optimisation–error correction–prediction framework for photovoltaic (PV) power generation forecasting. Their method integrates adaptive decomposition, least squares support vector machine (LSSVM) prediction, metaheuristic optimisation, and long short-term memory (LSTM)-based residual correction, yielding improved accuracy and robustness across multiple datasets. In parallel, Çıkan [9] examined multi-objective reconfiguration of Institute of Electrical and Electronics Engineers (IEEE) 123-bus unbalanced power distribution networks using meta-heuristic algorithms, offering valuable insight into the simultaneous improvement of power quality, power loss reduction, and network balance. Together, these contributions demonstrate the significance of AI in supporting intelligent, reliable, and sustainable energy systems.

The special issue also presents several contributions in robotics, human–robot interaction (HRI), and intelligent motion or expression generation. Alsubai et al. [10] proposed a multimodal framework for robotic motion planning that integrates symbolic reasoning, transformer-based fusion, and adversarial learning to generate physically realistic trajectories from multimodal human inputs. Their study highlights the potential of AI for interpretable and intention-aware robotic behaviour in unstructured environments. Trieu and Thinh [11] addressed emotional expressiveness in a biomechanical robotic head using a fuzzy-logic-based approach for actuator control, improving the realism and responsiveness of robotic facial expressions. These papers reflect the expanding role of AI in creating more adaptive, interactive, and human-centred robotic systems.

Beyond these areas, the issue includes notable contributions in communication networks, distributed intelligence, cybersecurity, and engineering process modelling. Reis and Gupta [12] investigated federated learning (FL) for vision-based applications in sixth-generation (6G) communication networks through a simulation-based framework, analysing the effect of communication bottlenecks, data heterogeneity, and client participation on convergence and performance. Their findings provide practical guidance for privacy-preserving learning in future AI-native networks. Shawly et al. [13] introduced a divide-and-conquer generative adversarial network (GAN) framework with squeeze-and-excitation and dual-attention mechanisms for spam email identification, achieving strong classification accuracy and demonstrating the value of advanced deep architectures for secure communication systems. In addition, Ashique et al. [14] applied artificial neural networks (ANNs) to the nonlinear analysis of Williamson nanofluid flow and heat transfer over a moving wedge, showing how AI can complement mathematical and numerical modelling in thermofluid and engineering process systems.

Taken together, the papers in this special issue present a broad yet coherent picture of how AI is being translated into effective engineering tools for real-world challenges. The published studies span infrastructure monitoring, thermofluid modelling, renewable energy forecasting, robotic motion generation, distributed intelligence, super-resolution imaging, power distribution optimisation, robotic emotional expressiveness, and cybersecurity. Although the specific application domains vary, all contributions share a common objective: to use AI not merely as a computational add-on, but as a central mechanism for improving performance, interpretability, automation, and engineering decision support.

The special issue also reflects an important broader trend: modern AI systems are becoming increasingly multimodal, optimisation-aware, privacy-conscious, and application-driven. The accepted papers collectively show that progress in engineering AI depends not only on algorithmic novelty but also on careful adaptation to domain-specific constraints, data characteristics, and operational requirements. We hope this collection will provide useful insights for researchers and practitioners working at the intersection of AI and engineering, and will encourage further innovation in solving practical and high-impact real-world problems.

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