

Feature Papers in Artificial Intelligence

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1. Introduction

Artificial intelligence has revolutionised numerous aspects of our society. Foundation models and embodied intelligence are expanding the frontiers of AI research, and the convergence of AI with fundamental sciences has accelerated scientific discovery across disciplines. This Feature Paper Special Issue was put together to showcase research that advances both the theoretical understanding and the practical application of AI technologies.

The call welcomed contributions across the full spectrum of AI research, from novel methodologies and theoretical frameworks to transformative applications. The scope also covered research on AI system development challenges—scaling approaches, low-cost deployment, system reliability, trustworthiness, and human–AI interaction paradigms—as well as submissions that bridge AI with other scientific fields, such as drug discovery and materials science. After the standard peer-review process, twenty-two papers were accepted and published in the Special Issue [Contributions 1–22] by groups based in Europe, Asia, and the Americas. The collection includes original research articles, two reviews, and several application papers.

Rather than forcing a single narrative, we briefly summarise the contributions below in the order of the main themes the issue ended up covering.

2. The Present Issue

Several papers deal with computer vision and multimodal perception. Apostolidis and Papakostas [Contribution 1] revisit the YOLO family of object detectors and study how their accuracy degrades under adversarial attacks and image corruption, a question that matters now that YOLO variants are routinely deployed in safety-critical settings. Baik et al. [Contribution 2] propose a residual network with masked dual-path convolution that explicitly separates high- and low-frequency information for image classification. Oh, Jung and Kim [Contribution 3] tackle the joint generation of physically based rendering and environment maps using a diffusion-based architecture (EnvMat), with immersive 3D content as the main target. Popescu, Florea and Florea [Contribution 4] focus on emotion recognition with vision–language models and show, using carefully constructed synthetic datasets, that VLMs are heavily influenced by the background of a scene; they then propose a multimodal method to mitigate this bias. The issue also includes a review by Wahba, Baldoni and Battisti [Contribution 5] on learning-based viewport prediction for 360-degree video, which points at the gaps that the next generation of systems will need to close.



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Language models and human-centred AI are the focus of another set of contributions. Sevilla-Salcedo et al. [Contribution 6] use a semantic word-guessing platform (Semantrix) to compare classical and Transformer-based embeddings under realistic user interaction; the 2×2 factorial design with real participants is worth noting, since it goes beyond the usual benchmark comparison. Kang et al. [Contribution 7] present Fic2Bot, a pipeline that uses LLMs and retrieval-augmented generation to derive persona-driven chatbots from works of fiction. Naganawa, Hirata and Yamada [Contribution 8] apply GraphRAG to a knowledge management problem in the physical internet, illustrating where graph-based retrieval pays off compared to plain RAG. Saidu and Wall [Contribution 9] couple a medical knowledge graph with an LLM for clinical decision support, paying particular attention to the traceability of the answers—a non-negotiable property in this domain. Caridi, Giovannini and Ricciardi Celsi [Contribution 10] explore the use of LLMs in value investing through a human-in-the-loop framework, and the paper is also a sober reading on the model risks involved.

Three contributions look at trustworthy and interpretable AI. García-Cuesta, Manrique and Ionescu [Contribution 11] take a critical view of prototype-based neural networks and show that the prototypes, normally presented as inherently interpretable, can be manipulated without losing the appearance of explainability. Lu et al. [Contribution 12] develop an explainable hybrid deep learning model for fault diagnosis in automotive electronic systems, where explanation is not a nice-to-have but a regulatory requirement. Theodorakopoulos, Theodoropoulou and Halkiopoulos [Contribution 13] step back and look at cognitive bias mitigation in executive decision-making, discussing both what XAI can do and what organisational barriers still get in the way.

Two papers come from the brain-inspired side of the field. Zuo et al. [Contribution 14] describe HDNIP, a high-density neuromorphic inference platform that combines a density-first architecture with a ReRAM-based near-memory strategy and reaches a neuron density two orders of magnitude above prior art. Lee and Lee [Contribution 15] tackle an often-overlooked problem of spiking neural networks in time-series tasks—the information loss introduced by spike encoding—and propose an information-preserving scheme.

The largest single group of papers applies AI to forecasting, energy, industrial systems, and networks. Du et al. [Contribution 16] design a short-term user-side load forecasting method that combines variational mode decomposition with frequency-domain features and multi-scale convolution. Volturino, Di Martino and Longo [Contribution 17] offer a critical comparison of machine learning models for state-of-charge prediction in electric bus fleets, paying attention to the data limitations of real deployments. Jammal et al. [Contribution 18] use Self-Organising Maps to learn energy states of automated storage and retrieval systems in an unsupervised manner. Sea surface temperature forecasting is covered in two complementary papers: Cuervo-Londoño et al. [Contribution 19] identify Voronoi-induced artefacts when graph neural networks are coupled to physical grids and propose bathymetry-aware meshes, while González-Santana, Cuervo-Londoño and Sánchez [Contribution 20] move to probabilistic forecasting using ensemble GNNs and structured input perturbations. The group closes with Abdulghani et al. [Contribution 21], who propose a network-aware Gaussian Mixture Model for controller placement in SD-WAN deployments.

Closer to the theoretical side, Solanes and Francés-Falip [Contribution 22] propose a geometry-aware conformal calibration of entropic soft-min operators with distribution-free guarantees, with applications in both machine learning and reinforcement learning. It is the kind of foundational work that will quietly benefit a number of applied papers downstream.

3. Conclusions

The papers collected here cover a wide stretch of AI research, from neuromorphic chips to the social consequences of biased decision support, and from low-level signal processing to language-model-driven reasoning. What we noticed across most of them, while reading them in preparation for this editorial, is a clear preoccupation with the conditions under which AI systems actually work in practice—data, robustness, interpretability, and deployment constraints—rather than with benchmark scores alone. We think this is a healthy direction. Our hope is that the Special Issue will be a useful starting point for readers entering any of these topics, and that some of the open questions raised by the authors will end up shaping future work.

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