

ARTIFICIAL INTELLIGENCE IN TECHNICAL AND APPLIED SCIENCES: INNOVATIONS AND DIGITAL TECHNOLOGIES

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Abstract. *Artificial Intelligence (AI) has revolutionized technical and applied sciences, driving innovations through digital technologies such as machine learning, big data analytics, and automation. This article explores the integration of AI in fields like engineering, materials science, and environmental monitoring, highlighting key advancements as of 2026. We discuss case studies, challenges, and future prospects, emphasizing AI's role in enhancing efficiency, sustainability, and problem-solving capabilities. Drawing from recent developments, the paper underscores the need for ethical frameworks and interdisciplinary collaboration to maximize AI's potential in technical domains.*

Keywords: Artificial Intelligence, Technical Sciences, Innovations, Digital Technologies, Machine Learning, Automation

Introduction

The convergence of Artificial Intelligence (AI) and technical-applied sciences represents a paradigm shift in how we approach innovation and problem-solving. AI, encompassing technologies like neural networks, deep learning, and natural language processing, integrates seamlessly with digital tools to augment human capabilities in engineering, physics, chemistry, and related fields. As of 2026, with advancements in quantum computing and edge AI, these integrations have accelerated, enabling real-time data processing and predictive modeling on unprecedented scales.

This article aims to elucidate the transformative impact of AI on technical sciences, focusing on innovations in digital technologies. We begin with a literature review, followed by discussions on specific applications, challenges, and future directions. The objective is to provide a comprehensive overview for researchers, practitioners, and policymakers interested in leveraging AI for societal benefits.

Literature Review

The evolution of AI in technical sciences can be traced back to the mid-20th century, but recent decades have seen exponential growth. Pioneering works, such as those by Turing (1950) on machine intelligence, laid foundational concepts, while modern contributions from Goodfellow et al. (2016) on deep learning have enabled practical applications.

In engineering, AI-driven simulations have optimized design processes. For instance, generative adversarial networks (GANs) are used in materials science to predict molecular structures (Sanchez-Lengeling & Aspuru-Guzik, 2018). In environmental sciences, AI models analyze satellite data for climate forecasting, as demonstrated in studies by Rolnick et al. (2019) on tackling climate change with machine learning.

Digital technologies amplify these efforts: Internet of Things (IoT) devices generate vast datasets, processed via AI for insights in smart manufacturing (Lee et al., 2018). Blockchain integration with AI ensures secure data handling in applied sciences, particularly in supply chain management (Kshetri, 2018).

Recent 2026 literature highlights edge AI in robotics, where decentralized processing reduces latency in autonomous systems (Chen et al., 2025). These advancements underscore AI's role in fostering innovation across technical domains.

Innovations in AI and Digital Technologies

AI in Engineering and Automation

AI has introduced innovative solutions in mechanical and civil engineering through predictive maintenance and optimization algorithms. For example, reinforcement learning models simulate structural integrity in bridges, predicting failures with 95% accuracy (Zhang et al., 2024). Digital twins—virtual replicas of physical systems—powered by AI, enable real-time monitoring, as seen in Siemens' industrial applications (Tao et al., 2018).

In manufacturing, Industry 4.0 leverages AI for cyber-physical systems, where machine learning optimizes production lines, reducing waste by up to 30% (Lu et al., 2020). Innovations like swarm robotics, guided by AI algorithms, enhance collaborative tasks in hazardous environments.

Applications in Materials and Chemical Sciences

Technical sciences benefit from AI in materials discovery. High-throughput screening via machine learning accelerates the identification of new alloys and polymers. A notable innovation is the use of graph neural networks to model atomic interactions, leading to breakthroughs in battery technology for electric vehicles (Butler et al., 2023).

Digital technologies, such as quantum-inspired AI, simulate chemical reactions at molecular levels, bypassing traditional lab experiments. This has implications for drug discovery and sustainable materials, with AI reducing development timelines from years to months (Goh et al., 2017).

Environmental and Geospatial Innovations

AI integrates with digital sensors for environmental monitoring. Satellite imagery processed by convolutional neural networks detects deforestation patterns, aiding conservation efforts (Hansen et al., 2013). In 2026, AI-driven climate models incorporate real-time IoT data for accurate weather predictions, mitigating natural disasters.

Innovations in geospatial technologies include AI-enhanced GIS systems for urban planning, optimizing resource allocation in smart cities (Batty, 2018).

Challenges and Ethical Considerations

Despite advancements, challenges persist. Data privacy in AI systems raises concerns, especially with GDPR and emerging regulations (Voigt & Von dem Bussche, 2017). Bias in algorithms can perpetuate inequalities in technical applications, necessitating diverse datasets (Buolamwini & Gebru, 2018).

Technical hurdles include computational demands; while cloud computing mitigates this, energy consumption remains high. Ethical frameworks, such as those proposed by the IEEE (2019), advocate for transparent AI in applied sciences.

Interdisciplinary collaboration is essential to address these, ensuring AI innovations align with sustainable development goals.

Conclusion

AI and digital technologies are pivotal in advancing technical-applied sciences, fostering innovations that address global challenges. From engineering optimizations to environmental safeguards, these tools offer transformative potential. However, realizing this requires overcoming ethical and technical barriers through collaborative efforts. This article calls for continued investment in AI research to drive sustainable progress.

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