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# Editorial: Deep learning for industrial applications

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Editorial on the Research Topic
Deep learning for industrial applications

## 1 Introduction

Artificial intelligence (AI) is playing a fundamental role in reshaping modern industry, transforming it into a realm characterized by high performance, safety, and sustainability. By optimizing manufacturing workflows and minimizing operational expenses and product flaws, AI-driven technologies are becoming essential tools in industrial innovation. The deployment of machine learning (ML) and deep learning (DL) methods allows for an effective processing and interpretation of massive datasets, which is critical for informed decision-making and strategic control. As we enter the era of Industry 5.0, the focus shifts toward integrating human capabilities with sophisticated, decentralized automation platforms. This emerging collaboration between people and machines promises a new level of customization, efficiency, and sustainability in the industrial output. Such synergy is essential for building adaptive systems that align with both economic goals and societal values. Furthermore, global efforts are accelerating the development of intelligent manufacturing systems, where interconnected machines equipped with sensor networks facilitate real-time communication and automation. These advancements significantly contribute to the realization of environmentally conscious and economically viable production models.

As industries pursue smarter and more sustainable operations, DL methods are being explored for autonomous decision-making through machine-to-machine communication. This approach leverages edge and IoT technologies for scalability, energy efficiency, and reduced latency. However, deploying models on resource-limited devices requires balancing performance and real-time constraints. Understanding how these systems operate under real-world conditions is essential. Moreover, industries like robotics, manufacturing, and autonomous transport require trustworthy, reliable AI systems to gain user confidence. Combined with modern sensors, communication and big data analytics platforms, DL methodologies will play a key role in assisting human operators and increasing overall productivity. In this scenario, designing intelligent systems capable of integrating sensors, controllers, wireless and communication technologies in an effective orchestration is essential for a sustainable production. Thus, AI researchers are focusing on methods to support smart factories in designing flexible, adaptable and modular production lines.

This Research Topic on *Deep Learning for Industrial Applications* aims to explore recent breakthroughs that are shaping the future of automated and responsive industrial operations. The collection of research articles spans a variety of implementations, each demonstrating how DL techniques are reshaping the way industrial problems are tackled. Core themes include sparse neural networks, human-in-the-loop AI, augmented reality, and sophisticated computer vision algorithms, to address diverse real-world challenges such as optimizing industrial processes, enhancing security, improving urban mapping, and advancing public health education. Douzandeh Zenoozi et al. investigate sparse Artificial Neural Networks (ANNs) to reduce the high computational demands of DL models for resource-constrained industrial edge devices, aiming for greater sustainability and efficiency. The study compares pruning techniques on ANNs for anomaly detection and object classification, finding that sparse ANNs, especially with the SET method, save energy without losing accuracy, making them ideal for industrial use. Huang et al. introduce a novel human-in-the-loop hybrid augmented intelligence approach to boost the safety, reliability, and efficiency of security inspection systems by integrating human and machine intelligence. It combines AI's strengths in routine contraband detection with human reasoning for complex situations. The method demonstrates that an hybrid method enhances risk perception, reduces human labor, and improves overall efficiency and decision-making for contraband detection. Dhara and Kumar address Salient Object Detection (SOD) challenges using a novel cGAN-based method, which employs an encoder-decoder generator to improve feature extraction and salient object segmentation. Key enhancements include Wasserstein-1 distance for stability and a spatial attention gate for intricate saliency cues, overcoming issues like training instability and poor context capture. Experimental evaluations on benchmark datasets show superior performance, demonstrating lower Mean Absolute Error (MAE) values compared to other state-of-the-art methods, highlighting its potential for precise object detection in various applications. Ypenga et al. present a generalizable data-driven pipeline for mapping transparent urban features like fences using standard segmentation models, tackling the challenge of transparent object detection. The proposed method uses street view imagery with a novel multi-line-based annotation style. Juan et al. introduce an augmented reality (AR) app designed to teach users how to interpret carbohydrate information on real packaged food labels. The app guides users to nutritional data and explains "carb choices". The authors define an effective tool for nutritional education, promoting healthier eating habits.

We hope these contributions will encourage further exploration and innovation in the field of intelligent industrial systems. We extend our sincere appreciation to all the authors for their valuable submissions, and to the reviewers for their meticulous evaluations that greatly enhanced the quality of the published works. We also wish to express our gratitude to Simon Victor Rees, Senior Content Specialist at Frontiers, for his consistent support and guidance throughout the editorial process.

## Author contributions

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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