

Editorial

Recent Advances in Robotics and Intelligent Robots Applications

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Robotics research has a unique allure for both academia and the industry due to its potential for groundbreaking innovation and real-world applications [1,2]. Robotics research and applications encompass a broad range of topics, challenges, and opportunities. The topics in this Special Issue represent just a small fraction of the diverse and interdisciplinary field of robotics, which intersects with areas such as materials science and mechatronics, computer science, hardware engineering, robot kinematics, and bionics [3,4]. Fast-paced development in sensor hardware, robot perception, smart decision-making strategy, and gripper designs allows robots to react in “real-time” to the environment and thus work intelligently alongside human beings [5]. More crucially, artificial intelligence (AI) integrated into robotic applications has the potential to revolutionize various aspects of human life, offering a wide range of benefits and support.

This Special Issue of *Applied Sciences*, entitled “Recent Advances in Robotics and Intelligent Robots Applications”, has 14 research papers, covering topics from bionics (contribution 1) and soft-material robot designs (contribution 14), infrared image algorithms (contribution 2), target tracking algorithms (contribution 3 and 7), hyperspectral image classification (contribution 4), manipulator control (contribution 5 and 8), and space image denoise and analysis methods (contribution 6 and 10) to motion and path planning (contribution 9, 11, 12, and 13). The demonstrated robot designs and algorithm development include novel low-cost robot designs with leaping abilities (contribution 1) and resilient meta-materials (contribution 14); an accurate model that identifies the thermal target (contribution 2); sophisticated neural network models that track solar positions with time scales (contribution 3); pixel-level hyperspectral image classification with neural networks (contribution 4); space manipulator control models in orbit (contribution 5); and image denoise methods for sky-based backgrounds (contribution 6); visual object tracking with convolution and correlation (contribution 7); pick-and-place models with small dataset training (contribution 8); mathematic models for continuum robots (contribution 9); analyses of the MTF of remote sensing cameras (contribution 10); time-varying method for global path planning (contribution 11); low-cost localization models with a sparse modular point matrix (SMPM) (contribution 12); and deep reinforcement learning combined with RRT for path planning (contribution 13). The spectrum of the contributed research spans a wide range of topics, from traditional image processing methods and robot designs to robot kinematic models and path and motion planning with deep learning approaches.

Soft robotics focuses on the research and development of robots with compliant and flexible structures that are inspired by natural organisms. These robots can better adapt to dynamic environments and are often used in applications such as medical robotics, search and rescue tasks, and outdoor exploration [6].

Similarly, bio-inspired robotics draws inspiration from biology to design robots that mimic the structure and behavior of living organisms. This includes biomimetic locomotion,



Citation: Song, Q.; Zhao, Q. Recent Advances in Robotics and Intelligent Robots Applications. *Appl. Sci.* **2024**, *14*, 4279. <https://doi.org/10.3390/app14104279>

Received: 24 April 2024

Revised: 14 May 2024

Accepted: 16 May 2024

Published: 18 May 2024



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sensory systems inspired by animal perception, and soft actuators inspired by muscles and tendons [7].

Manipulation focuses on the development of robotic arms and hands that are capable of grasping, manipulating, and interacting with objects in a dexterous and precise manner. Primary applications include industrial automation, warehouse logistics, and assistive robotics for space applications [8].

Motion planning involves the algorithms and techniques used to plan the path of a robot from the current state to a desired state while avoiding obstacles and adhering to constraints without any human intervention. Robot motion planning involves designing feedback systems to regulate the robot's motion, and this ensures that it executes its planned actions intelligently and safely [9].

Perception in robotics refers to the ability of robots to sense and understand their environment using various sensors, such as cameras, LiDAR, millimeter-wave radars, and ultrasonic sensors. This includes tasks such as object detection, recognition, localization, and mapping (well known as SLAM—simultaneous localization and mapping) [10].

Autonomous navigation involves enabling robots to move and navigate complex and dynamic environments without human intervention. This includes developing algorithms for localization, path planning, obstacle avoidance, and decision making under uncertainty [11].

Currently, machine learning and AI techniques are growing very fast, and incredibly, they are integrated into robotics, which enables them to learn using data and allows them to adapt to dynamic environments. This includes reinforcement learning for robotic control, deep learning for perception tasks, and probabilistic modeling for decision making. Recently, the transformer-based generative model (GPT) has been recognized as a technical revolution and is expected to fill the long-existing gap between robots and artificial general intelligence (AGI) [12].

On the other hand, space robotics technology involves the development and deployment of robotic systems for exploration, maintenance, construction, and other tasks in space environments [13].

In space, robotic systems are utilized for the maintenance and servicing of spacecraft and satellites in orbit. These robots can perform tasks such as refueling, repairing, and upgrading satellites; extending their operational lifetimes; and reducing the need for costly replacements. Robotic arms equipped with various tools and instruments are essential for performing precise tasks in space, such as capturing payloads, deploying instruments, and conducting repairs. These arms are often mounted on spacecraft, landers, or rovers. Space robots also require advanced navigation and localization systems to accurately determine their position and orientation relative to celestial bodies, obstacles, and other spacecraft [14]. This involves integrating sensors, such as cameras, LiDAR, GPS, and inertial measurement units (IMUs).

Space robotics technology plays a crucial role in advancing our understanding of the universe, enabling scientific exploration, supporting space missions, and laying the groundwork for future human exploration and settlement of space [15].

In summary, more novel research efforts have been emerging with more innovative topics, including humanoid robotics, bio-inspired design, collaborative robotics, and ethical considerations in robot deployment. Robotics will continue to drive advancements in automation, efficiency, safety, and human well-being, with ongoing efforts to address societal challenges and shape the future of technology.

Even though it is impossible to cover all research areas of robotics and related applications, this Special Issue provides a humble collection of selected topics with cutting-edge research, and it hopes to show recent primary achievements from intuitive aspects. We would like to take this opportunity to thank all the contributing authors and reviewers of this Special Issue for their excellent research work and valuable time spent on providing comments for the collected papers. Finally, the unconditional and generous support from the editorial staff of *Applied Sciences* is also a key to this high-quality Special Issue.

Conflicts of Interest: The authors declare no conflict of interest.

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