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Editorial

Special Issue on Advances in Robotics-Based Automation Systems

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Automation systems based on robotics have emerged as a multidisciplinary frontier of science and engineering. Due to its high potential to contribute to breakthroughs in many areas of technology, advances in robotics-based automation systems are capturing the interest of many researchers across a wide range of fields. Robotics is known as an interdisciplinary system that integrates mechanical engineering, electronic engineering, software engineering, computer science and others. It can be used in many areas for myriad specific purposes, such as automation manufacturing processes, dangerous environments, or situations to which humans cannot adapt. During the rapid industrialization progress seen in recent years, automation systems integrated with robotics have led to significant achievements beyond mechanization. With the considerable progress in software, hardware, and Industry 4.0 technology, improvements based on robotics-based automation systems and integration can resolve even the most complex problems in automatization, product defect detection, unmanned manufacturing, mechatronics, automation measurement and control, etc. Papers based on novel methodologies and implementations, creative and innovative automation systems, and associated integration engineering are welcome.

This Special Issue aims to provide an overview on the latest developments in robotics-based integration systems and their roles in different automation application domains in industry. Topics of discussion include but are not limited to the exploration of new directions of robotics-based science and application technology that enables technological breakthroughs in high-impact areas such as product quality inspection, signal measurement and processing, signal sensing technology, intelligent robotic control, automation system integration, etc.

Featured in this Special Issue are a total of eight papers (seven research papers and one review paper) from various fields of robotics-based automation technology including nonlinear discrete-time singular systems, pattern recognition, robot location tracking, weld seam grinding, UAVs path planning, control of spherical robots, service robots, and exoskeleton robots. Chang et al. [1] developed the observer-based fuzzy controller algorithm for nonlinear discrete-time singular systems. Based on the Lyapunov theory and projection lemma, the stability criteria were built from linear matrix inequalities (LMI). Additionally, the gains obtained from both fuzzy controller and fuzzy observer can be calculated synchronously by using convex optimization algorithms. The proposed fuzzy control method was verified to be effective by a biological economic system. Lu et al. [2] reported a robotics-based touch panel test system using pattern recognition methods. In this system, the Chinese characters and Mandarin phonetic symbols can be recognized. The mechanical arm was used to implement corresponding movements and edit words on the screen. The joint angles of the robot arm during the movement control scheme can be calculated using the Denavit–Hartenberg parameters (D-H) model and fuzzy logic system. Up to 90 percent recognition accuracy for Chinese Mandarin phonetic symbols can be reached. Cree et al. [3] reported a Tracking Robot Location approach for non-destructive evaluation of double-shell tanks. The robot location was continuously monitored using

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video image analysis for short distances and laser ranging for absolute location. The decision was supported according to location tracking as well as automated data collection. Li et al. [4] designed a robot grinding system and monitoring method for friction stir weld seams. The designed system consisted of an industrial robot, a line scanner for measuring the weld seam and a force-controlled grinding tool. The extraction method of the weld seam point cloud based on graph-cut was proposed, where the extracted features were used as prior knowledge of the monitoring algorithm. The experiments demonstrate that excessive grinding can be identified, and the accuracy of recognition reached 91.5%. Shi et al. [5] proposed a multiple swarm fruit fly optimization algorithm (MSFOA) to solve the coordinated path planning problem for multi-UAVs. The searching space was expanded with multi-tasks to improve the searching ability, while the offspring competition strategy was introduced to improve the utilization degree of each calculation result. It showed that the proposed MSFOA was superior to the original FOA in terms of convergence and accuracy. Zhou et al. [6] studied the control of spherical robot linear motion under input saturation. Based on the Lyapunov stability theorem, the closed-loop system was verified globally stable. Moreover, the desired state was achieved using the fractional sliding mode controller. The simulation results revealed that the proposed controller was superior to fractional order sliding mode controllers and the integer order controller. Tao et al. [7] reported a re-entry path planning method for service robots based on dynamic Inver-Over evolutionary algorithm. A local operator was combined with features of the dynamic travelling salesmen problem (DTSP) for path planning. The problem of the number of cells undergoing dynamic changes over time in the operation of cleaning robots can therefore be resolved.

Nguiadem et al. [8] reviewed motion planning of upper-limb exoskeleton robots. In this study, the authors firstly explored the methods of trajectory planning for exoskeleton control. Secondly, the paper systematically conducted a search for related literature from the last 20 years. Thirdly, a total of 67 relevant papers were discovered, whose results were then classified into two main categories of methods to plan trajectory. Finally, some challenges associated with trajectory planning, namely, kinematic redundancy, incompatibility, and the trajectory optimization problem, are unveiled and discussed in more detail.

In modern industry, the increasing demand for advanced robotics-based automation systems continues to grow. In future work, more in-depth research in this field, such as the integration of AI, image processing, IOT and control should be further investigated and studied.

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