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Editorial

Advanced Autonomous Machines and Design Developments

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Citation: Karimi, H.R.; Cheng, K.; Zou, Y. Advanced Autonomous Machines and Design Developments. *Machines* **2022**, *10*, 491. https://doi.org/10.3390/machines10060491

Received: 2 June 2022
Accepted: 14 June 2022
Published: 20 June 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

With the rapid technological development of machines in different applications such as vehicles, robotics, and manufacturing, concerns may arise with regard to complexity, safety, performance, and maintenance costs associated with the machine operation. To partly overcome these challenges, the concept of autonomy was introduced to machines, which means that machines are able to operate with minimal influence from external controllers or users. The functionality of autonomous machines depends on the integration of mechanical, electrical, or hydraulic components with informational components to reach a higher level of autonomy in machine operation (e.g., production or motion control). Toward this aim, the operation of autonomous machines is mainly related to local environment-sensing technology, remote control technology, and interaction with their environment. For instance, the inclusion of the concept of autonomy in manufacturing processes can enhance accuracy, consistency, data collection, and connectivity in operational processes.

The goal of this Special Issue is to address some recent theoretical and technological advances in autonomous machines and design developments.

With a stringent peer review process, there are nine papers finally included in this Special Issue, which cover the following aspects: (1) Autonomy in Machines and Designs and (2) Autonomous Control and Robotics. A summary of the accepted papers is discussed below.

In the context of autonomous quality management in manufacturing, an in-depth review of the recent advances and challenges for the development of a smart quality management system is addressed by the authors of [1] for intelligent digitization of all company manufacturing and business processes. Specifically, a data-based welding quality management framework is described for laser micro-welding applications and their implementation perspectives. In [2], the authors propose a simulation-based analysis for hydrostatic bearings and the supported spindle applied to a high-precision internal grinding machine. The result is also verified experimentally, which can be considered a basis for more effective and accurate design and analysis of the hydrostatic thrust bearing and the spindle and their application on a high precision internal grinding machine.

The authors of [3] aim to improve the finishing efficiency of the magnetic abrasive finishing combined with electrolytic (EMAF) process. Specifically, a series of experiments are conducted to explore the feasibility of using the compound processing tool to finish the aluminum alloy A5052 and to preliminarily explore the machining mechanism. Surface roughness and material removal are used to evaluate the finishing effect and the finishing efficiency, respectively. The results are verified experimentally. In order to further develop the process, the authors of [4] developed the MAF process using an alternating magnetic field, and it was proven that the alternating magnetic field has advantages compared with the static magnetic field. Then, the experimental results are provided to illustrate the superiority of the proposed method.

Within the context of autonomous control vehicles, the authors of [5] proposed an Iterative Learning Control combined with linear extended state observer to improve the control accuracy of Automated Guided Vehicle (AGV) drive motor. In regard to medical devices for motion assistance, the authors of [6] design an elbow-assisting device based on a cable-driven parallel mechanism with design solutions. Then, experimental results are provided, and some concluding remarks are addressed as well. The author of [7] developed a position control for a DC-motor using vibrational control theory and implementation based on Hall-effect sensor measurements. Specifically, this controller is realized by utilizing analog electronics via operational amplifiers. Experimental results are provided to illustrate the main contributions of the paper. The authors of [8] propose a model-based methodology for the online estimation of the interaction wrench, implementing a 6D virtual sensor using an Extended Kalman Filter. In addition, experimental tests are performed employing a Franka EMIKA panda robot to validate the proposed method. Finally, in [9], the authors propose a multiscale modelling for the design and development of the aerostatic bearing slideways and its digital twin, which cover the mechanical design, direct-drive and control, dynamics tuning of the slideway, and their entire mechatronic system integration.

Author Contributions: Conceptualization, H.R.K., K.C. and Y.Z.; writing—original draft preparation, H.R.K., K.C. and Y.Z.; writing—review and editing, H.R.K., K.C. and Y.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This work was partially supported by the Italian Ministry of Education, University and Research through the Project "Department of Excellence LIS4.0-Lightweight and Smart Structures for Industry 4.0".

Acknowledgments: We appreciate all the authors and anonymous reviewers who contributed to this Special Issue. Meanwhile, we would like to thank the support from the Editorial Staff for our Special Issue.

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

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