Guest Editorial Special Issue on the 2020 International Conference on Automation Science and Engineering

WE ARE pleased to present this Special Issue of TASE, including 12 extended articles selected from the technical program of the 2020 International Conference on Automation Science and Engineering (CASE2020). CASE2020 was held virtually due to the COVID19 pandemics, August 20–21, 2020, and was originally scheduled in Hong Kong, China. CASE is an offspring of TASE and is the flagship automation conference of the IEEE Robotics and Automation Society, constituting the primary forum for cross-industry and multidisciplinary research in automation. The 2020 CASE theme was Automation Analytics, a global challenge emphasized at the conference by several invited and regular sessions, as well as specific workshops.

We had the honor to serve in various roles in the organization and program committee of CASE2020. We take this occasion to offer our sincere thanks for all their hard work and dedication to the Conference General Chairs, Prof. George Q. Huang, University of Hong Kong, Hong Kong, China, and Prof. Michael Y. Wang, Monash University, Melbourne, Australia, as well as to the entire CASE2020 team, particularly to the Conference Editorial Board, led by Prof. Jingshan Li, University of Wisconsin–Madison, Madison, USA.

Among the 276 excellent presentations at CASE2020, and after an extremely thorough peer-review process, 12 extended versions of the original CASE2020 articles were finally selected for inclusion in this Special Issue. These contributions can be classified into four main categories: 1) automation for smart energy systems (three articles); 2) automation for smart farming systems (two articles); 3) automation for smart manufacturing systems (three articles); and 4) automation for smart navigation systems (four articles).

In the category of Automation for Smart Energy Systems, in [A1], Yang *et al.* develop an event-triggered hybrid system model for cascading failure with multiple physical responses in power grids. The model can provide fast control strategies to prevent failure propagation. In [A2], Wu *et al.* present a dynamic pricing mechanism for industrial parks with demand response programs. Based on the developed prediction model, the authors propose a real-time prices spike detection model, which can detect prices spike hourly by history data and give rolling prices spike warnings. In [A3], Carli *et al.* address the important theme of demand-side management in microgrids where both gas and electricity are provided to the customer. The authors propose a robust model predictive control approach whose goal is to minimize the total economic cost while satisfying comfort and energy requests of the final users and considering data uncertainties in the microgrid.

The articles that belong to category 2) are dedicated to Automation for Smart Farming Systems. In [A4], Avigal *et al.* present a fast, first-order, open-access polyculture farming simulator with single plant growth and irrigation models that are tuned using real measurements. The simulator can be used in polyculture farming, where multiple crop species are grown simultaneously, both for simulating the plant growth and for evaluating automation policies, using a novel metric that is proposed in the manuscript. In [A5], Yigit *et al.* present a machine learning-enabled, wearable inertial sensor-based design that provides an effective and efficient approach for horse limb lameness detection and pose estimation applications.

In the category of Automation for Smart Manufacturing Systems, in [A6], Gleeson *et al.* present a novel method for spray paint optimization. The approach can be used in manufacturing systems, particularly in the automotive sector, to address and simplify the important issue of generating spray robot trajectories. In [A7], Wang *et al.* present an efficient graph guidance mechanism into convolutional neural networks to improve the ability of feature extraction and thus achieve better performance. The approach can be effectively employed to solve the problem of surface defects in manufacturing systems using vision-based recognition to ensure the surface quality of products. In [A8], Roselli *et al.* present a novel compositional algorithm for automatically solving the so-called Conflict-Free Electric Vehicle Routing Problem. The problem finds many manufacturing applications, particularly for highly automated material handling systems.

Articles that belong to category 4) are dedicated to Automation for Smart Navigation Systems. In [A9], Li *et al.* present two novel motion planning algorithms, to quickly generate time-optimal trajectories for multiple micro agents sharing global external fields. The two algorithms efficiently manipulate multiple microscopic objects, an issue of major interest in various research applications where fully autonomous fleets of micro- and nanorobots are present. In [A10], Vallon and Borrelli propose a hierarchical learning architecture for safe data-driven control in unknown environments. The authors prove the feasibility of the resulting control policy and apply the proposed method to robotic path planning, racing, and computer game applications. In [A11], Obute *et al.* address swarm foraging, a common test case application for multi-robot systems. They propose a novel

Digital Object Identifier 10.1109/TASE.2022.3180469

algorithm for improving the coordination of a robot swarm by selectively broadcasting repulsion and attraction signals using a chemotaxis-inspired search behavior where robots use the temporal gradients of these signals to navigate toward more advantageous areas. In [A12], Júnior *et al.* are motivated by the challenges of autonomous navigation for mobile ground robots within confined and unstructured environments. The authors propose a data fusion framework that uses common sensors to improve the simultaneous localization and mapping capabilities of a robot without GPS and compass.

We are convinced that this Special Issue exemplifies in a great manner the rich and diverse flavor of the CASE2020 program, with many innovative ideas and methods of implementation.

We conclude this Editorial by thanking all the authors for their high-quality contributions. We are also indebted to all associate editors and anonymous reviewers for their professional and valuable work that helped improve all manuscripts. Last but not least, we express our gratitude to the TRANSACTIONS' Editor-in-Chief, Prof. Yu Sun, and to the Editorial Assistant, Rebecca Hytowitz, for their invaluable support.

MARIAGRAZIA DOTOLI, *Lead Guest Editor*
Department of Electrical and
Information Engineering
Politecnico di Bari
70126 Bari, Italy

WEIMING SHEN, *Guest Editor*
School of Mechanical Science and Engineering
Huazhong University of Science and Technology
Wuhan 430074, China

(SAMUEL) QING-SHAN JIA, *Guest Editor*
Department of Automation
Tsinghua University
Beijing 100190, China

RAY Y. ZHONG, *Guest Editor*
Department of Industrial and Manufacturing
Systems Engineering
The University of Hong Kong
Hong Kong, China

APPENDIX: RELATED ARTICLES

[A1] Y. Yang *et al.*, "An event-triggered hybrid system model for cascading failure in power grid," *IEEE Trans. Autom. Sci. Eng.*, early access, May 19, 2022, doi: 10.1109/TASE.2022.3169069.

[A2] J Wu, L Wu, Z Xu, X Qiao, X Guan, "Dynamic pricing and prices spike detection for industrial park with coupled electricity and thermal demand," *IEEE Trans. Autom. Sci. Eng.*, early access, Jan. 18, 2022, doi: 10.1109/TASE.2021.3139825.

[A3] Raffaele Carli *et al.*, "Robust optimal control for demand side management of multi-carrier microgrids," *IEEE Trans. Autom. Sci. Eng.*, early access, Feb. 16, 2022, doi: 10.1109/TASE.2022.3148856.

[A4] Y. Avigal, W. Wong, M. Presten, M. Theis, S. Aeron, and A. Deza, "Simulating polyculture farming to learn automation policies for plant diversity and precision irrigation," *IEEE Trans. Autom. Sci. Eng.*, early access, Jan. 17, 2022, doi: 10.1109/TASE.2021.3138995.

[A5] T. Yigit *et al.*, "Wearable inertial sensor-based limb lameness detection and pose estimation for horses," *IEEE Trans. Autom. Sci. Eng.*, early access, Mar. 28, 2022, doi: 10.1109/TASE.2022.3157793.

[A6] D. Gleeson *et al.*, "Generating optimized trajectories for robotic spray painting," *IEEE Trans. Autom. Sci. Eng.*, early access, Mar. 16, 2022, doi: 10.1109/TASE.2022.3156803.

[A7] Y. Wang, L. Gao, Y. Gao, and X. Li, "A graph guided convolutional neural network for surface defect recognition," *IEEE Trans. Autom. Sci. Eng.*, early access, Jan. 14, 2022, doi: 10.1109/TASE.2022.3140784.

[A8] S. F. Roselli, P.-L. Götvall, M. Fabian, and K. Åkesson, "A compositional algorithm for the conflict-free electric vehicle routing problem," *IEEE Trans. Autom. Sci. Eng.*, early access, May 3, 2022, doi: 10.1109/TASE.2022.3169949.

[A9] X. Li, J. Wu, J. Song, and K. Yu, "Informed sampling-based motion planning for manipulating multiple micro agents using global external electric fields," *IEEE Trans. Autom. Sci. Eng.*, early access, Mar. 14, 2022, doi: 10.1109/TASE.2022.3151872.

[A10] C. S. Vallon and F. Borrelli, "Data-driven strategies for hierarchical predictive control in unknown environments," *IEEE Trans. Autom. Sci. Eng.*, early access, Jan. 10, 2022, doi: 10.1109/TASE.2021.3137769.

[A11] S. O. Obute, P. Kilby, M. R. Dogar, and J. H. Boyle, "Swarm foraging under communication and vision uncertainties," *IEEE Trans. Autom. Sci. Eng.*, early access, Apr. 15, 2022, doi: 10.1109/TASE.2022.3164044.

[A12] G. P. C. Júnior *et al.*, "EKF-LOAM: An adaptive fusion of LiDAR SLAM with wheel odometry and inertial data for confined spaces with few geometric features," *IEEE Trans. Autom. Sci. Eng.*, early access, doi: 10.1109/TASE.2022.3169442.

Mariagrazia Dotoli (Senior Member, IEEE) received the Laurea degree (Hons.) in electronic engineering and the Ph.D. degree in electrical engineering from the Politecnico di Bari, Italy.

She was a Visiting Scholar at Paris 6 University, France, and the Technical University of Denmark. She has been an Expert Evaluator of the European Commission since 2002. She joined as an Assistant Professor with the Politecnico di Bari in 1999, where she is currently a Full Professor in Automatic Control. She is the Founder and the Coordinator of the Italian National Ph.D. Program on Autonomous Systems. She is also the Vice-Rector for Research at the Politecnico di Bari and a Member Elect of the Academic Senate. She is the author of more than 250 publications, including one textbook (in Italian) and more than 70 international journal articles. Her work is cited in Google Scholar with an H-index of 40. Her research interests include modeling, identification, management, control, diagnosis, and optimization of discrete event systems, manufacturing systems, logistics systems, traffic networks, and energy systems.

Prof. Dotoli was a member of the International Program Committee of more than 80 international conferences. She was the Co-Chair of the Training and Education Committee of ERUDIT and the European Commission Network of Excellence for Fuzzy Logic and Uncertainty Modeling in Information Technology. She was the General Chair of the 2021 Mediterranean Conference on Control and Automation. She is the General Chair of the 2024 IEEE Conference on Automation Science and Engineering. She was a key node representative of the European Network of Excellence on Intelligent Technologies (EUNITE). She is a Senior Editor of the IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING and an Associate Editor of the IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS: SYSTEMS.

Weiming Shen (Fellow, IEEE) received the bachelor's and master's degrees in mechanical engineering from Northern (Beijing) Jiaotong University, Beijing, China, in 1983 and 1986, respectively; and the Ph.D. degree in system control from the University of Technology of Compiègne, Compiègne, France, in 1996.

He is currently a Professor with the Huazhong University of Science and Technology (HUST), Wuhan, China, and an Adjunct Professor with the University of Western Ontario, London, ON, Canada. Prior to joining HUST in 2019, he was a Principal Research Officer at the National Research Council Canada. His work has been cited over 16,000 times with an H-index of 61. His research interests include agent-based collaboration technologies and applications, collaborative intelligent manufacturing, the Internet of Things, and big data analytics. He has published several books and over 560 articles in scientific journals and international conferences in the related areas.

Prof. Shen is the Co-Chair of the IEEE SMC Technical Committee on Computer Supported Cooperative Work in Design. He has been the Program Committee Co-Chair of the CSCWD conferences since 2001. He served as the general chair/co-chair or the program committee chair/co-chair for over 30 international conferences. He is the Editor-in-Chief of the *IET Collaborative Intelligent Manufacturing* and an Associate Editor or an Editorial Board Member of over ten international journals, including IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS: SYSTEMS, *IEEE Systems, Man, and Cybernetics Magazine*, *Advanced Engineering Informatics*, and *Service Oriented Computing and Applications*. He has served as a guest editor for several international journals.

(Samuel) Qing-Shan Jia (Senior Member, IEEE) received the B.S. degree in automation and the Ph.D. degree in control science and engineering from Tsinghua University, Beijing, China, in 2002 and 2006, respectively.

He was a Visiting Scholar at Harvard University, The Hong Kong University of Science and Technology, and the Massachusetts Institute of Technology, in 2006, 2010, and 2013, respectively. He is currently an Associate Professor with the Beijing National Laboratory for Information Science and Technology (BNRist), Center for Intelligent and Networked Systems (CFINS), Department of Automation, Tsinghua University. His research interests include theories and methods for the simulation and optimization of cyber-physical systems, with applications to smart buildings and smart cities.

Prof. Jia was the Program Chair of the 2017 IEEE Conference on Automation Science and Engineering. He was an Associate Editor of IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING and *Discrete Event Dynamic Systems: Theory and Applications*. He is an Associate Editor of IEEE TRANSACTIONS ON AUTOMATIC CONTROL and IEEE CONTROL SYSTEMS LETTERS.

Ray Y. Zhong (Member, IEEE) received the B.S. degree in mathematics and computer science and technology from Gannan Normal University, China, in 2004, the M.S. degree in signal and information processing from the Guangdong University of Technology, China, in 2009, and the Ph.D. degree in industrial and manufacturing systems engineering from The University of Hong Kong, China, in 2013.

He was a Lecturer with the Department of Mechanical Engineering, The University of Auckland, from June 2016 to January 2019. He is currently an Assistant Professor with the Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong. His research interests include smart construction supply chain management, IoT-enabled manufacturing, and big data in manufacturing.

Dr. Zhong is a member of HKIE, CIRP RA (2017–2020), IET, and ASME. He was a recipient of the Best Conference Paper Award in the 2018 and 2014 IEEE International Conference on Networking, Sensing and Control (ICNSC2018 and 2014), the 2018 Best Paper of *International Journal of Production Research*, and the Certificate of Merit in the Hong Kong U-21 RFID Awards in 2011 and GS1 HK.