Guest Editorial Special Section on the 20th International Conference on Advanced Robotics—ICAR2021

I. Introduction

THE IEEE TRANSACTIONS ON MEDICAL ROBOTICS AND BIONICS (T-MRB) is a joint initiative of the two IEEE Societies for Robotics and Automation - RAS - and Engineering in Medicine and Biology - EMBS.

T-MRB is a multidisciplinary journal that aims to publish peer-reviewed papers focusing on innovative research ideas and medical application results, reporting on important theoretical findings and application case studies in the fields of medical robotics and bionics.

The 20th International Conference on Advanced Robotics (ICAR2021) brought together a number of conference papers that fit very well thematically with four of the six Journal Areas covered in T-MRB: Surgical Robotics, Rehabilitation and Assistive Robotics, Sensory Substitution, and Medical Biomimetic Technologies.

The editorial decision to link this issue (*Volume 4 Issue 3*) of T-MRB with ICAR2021 is based on the fact that the topics of ICAR2021 align very well with the core areas of IEEE T-MRB.

As part of the Covid period, ICAR2021 began using conference remote tools. 233 manuscript proposals were received, of which 64 did not meet the peer review thresholds, and 169 were presented at the conference. All manuscripts underwent full peer review, with each manuscript reviewed by 2 to 3 experts in the respective field.

II. Special Section Content

This Special Section contains 4 manuscripts that are improved journal versions of original papers among the best submitted to ICAR2021.

The Guest Editors of this Special Section, Prof. Alicia Casals, Universitat Politècnica de Catalunya, Spain, and Prof. Marko Munih, University of Ljubljana, Slovenia, invited the authors of 13 highly ranked ICAR2021 manuscripts on different topics and geographical regions to submit extended journal versions of their conference papers to the Special Section. The extended manuscripts were fully peer-reviewed by 2 or 3 different experts.

The final contributions accepted for publication in this Special Section cover different areas of bionic applications and novel rehabilitation robotic systems tested in realistic applications. The sequence in which the papers appear is of no particular significance.

The paper by Paredes-Acuña *et al.* [A1] addresses robotic skin in which the exoskeleton detects movement intent by measuring acceleration, proximity, and interaction forces. This enables the implementation of control modes inspired by physiotherapy, such as passive motion, active support, resistance training, and corrective therapy.

The paper by Plasberg *et al.* [A2] is inspired by insects and other walking life forms by using the redundancy of a six-legged robot to increase mobility in the event of damage. Without having to disconnect parts of the robot, it is reconfigured to minimize the effects of damage, and it can continue walking with sparing one leg. A static stable position is maintained at all times so that potential cargo is always safe.

In [A3] by Vazoler *et al.*, the gravity compensation is implemented with passive elastic elements to minimize weight. A detailed analysis tool is developed to assist the designer in the preliminary design phase by investigating the kinetic-static behavior of the exoskeleton and deriving optimal design parameters for the springs in the working range of the human arm.

The paper by Costi *et al.* [A4] describes the implementation of the soft flexible peristaltic pump and inlet-pump-outlet system, provides an analytical model to predict pump performance, and shows experimental results. Computer simulation is used to further characterize the device.

III. Conclusion

This Special Section is well in line with the important progress made in last decade in the area of Medical Robotics and Bionics.

The wide range of papers published in this Special Section reflects the ever-increasing number of applications in many different areas of the IEEE T-MRB. The progress is gratifying and seems to be a logical consequence of numerous PhD topics, national and various international projects, including EU programs, as well as complementary funding in the USA, Japan, China, and South Korea.

In particular, we hope that this Special Section will serve as a stimulus for further development of simulation tools, new demonstration prototypes, and not to neglect a large number of new start-ups that are taking basic research to new TRL levels.

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In closing, we would like to extend our appreciation to the conference editorial board, program and organizing committee of the ICAR2021, all reviewers of ICAR2021 papers and T-MRB peer-reviewers of the manuscripts submitted to this Special Section for their timely and professional comments.

Special thanks to all the authors who submitted their manuscripts for consideration.

Last but not least, we want to thank the Editor-in-Chief, Prof. Paolo Dario, and the Editorial Assistant, Rossella Raso, Ph.D., for their timely technical support. It has been a great pleasure working with you on this Special Section.

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APPENDIX: RELATED ARTICLES

[A1] N. Paredes-Acuña, N. Berberich, E. Dean-León, and G. Cheng, "Tactile-based assistive method to support physical therapy routines in a lightweight upper-limb exoskeleton," *IEEE Trans. Med. Robot. Bionics*, vol. 4, no. 3, pp. 541–549, Aug. 2022, doi: 10.1109/TMRB.2022.3188429.

[A2] C. Plasberg, A. Roennau, and R. Dillmann, "Adaptation of walking-patterns to damage for the six-legged walking robot LAURON V," *IEEE Trans. Med. Robot. Bionics*, vol. 4, no. 3, pp. 550–557, Aug. 2022, doi: 10.1109/TMRB.2022.3185425.

[A3] G. Vazzoler, P. Bilancia, G. Berselli, M. Fontana, and A. Frisoli, "Analysis and preliminary design of a passive upper limb exoskeleton," *IEEE Trans. Med. Robot. Bionics*, vol. 4, no. 3, pp. 558–569, Aug. 2022, doi: 10.1109/TMRB.2022.3186903.

[A4] L. Costi, J. Hughes, J. Biggins, and F. Iida, "Bioinspired soft bendable peristaltic pump exploiting ballooning for high volume throughput," *IEEE Trans. Med. Robot. Bionics*, vol. 4, no. 3, pp. 570–577, Aug. 2022, doi: 10.1109/TMRB.2022.3192763.