

# Challenges in Mechanism Design for Robotics

**Marco Ceccarelli**

*LARM2: Laboratory of Robot Mechatronics, Dept of Industrial Engineering, University of Roma Tor Vergata, Rome, Italy -<https://larm2.ing.uniroma2.it> e-mail: [marco.ceccarelli@uniroma2.it](mailto:marco.ceccarelli@uniroma2.it)*

## Abstract.

Challenges in Mechanism Design for Robotics and Mechatronics can be considered from several viewpoints in technical, social, and financial ones as due to new designs and applications, mainly in service fields. In this lecture the main issues are discussed in terms of Innovation aspects coming from Mechanism Design. The attention is focused on challenging aspects that are related to the mechanical structure of a modern system as for the structure and operation when considering assigned tasks either in substituting or helping human operators. The lecture presents aspects emphasizing the role of mechanism design in developments of robotic systems as since the action in performing tasks, either in coordination or not with human operators, is of mechanical nature due to motion and force transmission goals of the operation. The challenges of mechanism design are presented both in terms of technical solutions and community activity, since each of them depends, impacts, and generates each other. Examples of past and current solutions are presented to show how a mechanism design can be determinant for novel successful achievements and community developments. In particular, the activities at LARM2 in Rome are outlined on topics and systems that can be available for collaborations both in research and joint student formation.

**Keywords:** Robotics and Mechatronics, Mechanism Design, Innovation, History of MMS



**Marco Ceccarelli**, born in Rome in 1958, is Professor of Mechanics of Machines at the University of Rome Tor Vergata, Italy, where he chairs LARM2: Laboratory of Robot Mechatronics. His research interests cover the subjects of robotics, mechanism design, medical devices, experimental mechanics, and history of mechanical engineering with several published papers in the fields of Robotics and Mechanical Engineering. He has been visiting professor in several universities in the world while he received several honors and awards. He is ASME fellow. Professor Ceccarelli serves on several Journal editorial boards and conference scientific committees. He is editor-in-chief of the MDPI journal Robotics and of the SAGE

International Journal on Advanced Robotic Systems for the area on Service Robotics He is editor of the Springer book series on Mechanism and Machine Science (MMS) and History of MMS. He has been the President of IFToMM, the International Federation for the Promotion of MMS in 2008-11 and 2016-19. More information at the web page: LARM2 webpage: <https://larm2.ing.uniroma2.it/marco-ceccarelli/>

## Main references by author's publications

Lovasz, EC., Ceccarelli, M., Ciupe, V. (eds) Mechanism Design for Robotics. MEDER 2024. Mechanisms and Machine Science, vol 166.

Springer, Cham. <https://doi.org/10.1007/978-3-031-67383-2>

Ceccarelli M., Innovation Challenges for Mechanism Design, Mechanism and Machine Theory, 125 (2018) 94–100. DOI 10.1016/j.mechmachtheory.2017.11.026

Ceccarelli M. Challenges in service robot devices for elderly motion assistance. Robotica. Published online 2024:1-14. doi:10.1017/S0263574724001528

Ceccarelli M., Fundamentals of Mechanics of Robotic Manipulation, Springer, Cham, 2022 (second Edition). ISBN 978-3-030-90846-1. <https://link.springer.com/book/10.1007/978-3-030-90848-5>

