Mechatronic and Embedded Systems for Robotics and Mobile Machines

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Published online: 13 December 2017
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The term “mechatronics” was originally created by Tetsuro Mori, an engineer of Yaskawa Electric Corporation, who also registered it as a trademark in 1971. When it was released for public use, it was quickly adopted by the German automotive industry but soon spread all over the world.

The word “mechatronics” blends the terms “mechanics” and “electronics” but in a holistic view it represents more than the mere combination of such technological fields, since it also integrates control theory and computer science within product design and manufacturing.

Of course robotics was since the origin the most important and visible instance of such concept, so that “mechatronics” and “robotics” are often considered synonymous. It is therefore well deserved the place that MESA, the well-known IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications, traditionally leaves for the Symposium on Robotics and Mobile Machines and it is for us an honour to have the opportunity to collect the best robotics papers of the Conference in a highly-reputed venue as the Journal of Intelligent & Robotic Systems.

The goal of this special issue is to contribute to research in this field by presenting to a wider audience the latest results reached by a selected group of top researchers and scientists of different geographic regions and scientific interests. To this aim we have asked some researchers that presented their work at the 12th IEEE/ASME MESA International Conference held in Auckland (New Zealand) in August 2016 to prepare an extended version of their

papers that contained the new results obtained in the meantime. Thirteen papers have been invited and ten manuscripts have been received and reviewed by at least three international reviewers with expertise in the specific field; after a two-stage reviewing process, six articles have been finally retained and collected in the present special issue.

The main topics addressed by these papers are: design of robots for rehabilitation, dextrous robotics grippers and wrists, bio-inspired underwater robotics, human-robot collaboration, robotic vision.

Jonathan D Realmuto et al. study the collaborative human-robot output tracking when the desired output is only known to the human but not to the robot controller: they propose an iterative learning algorithm that updates the robot input by putting the human action in the loop.

Matteo-Claudio Palpacelli et al. developed an error kinematic model of a mini spherical robot, aimed at its kinematic calibration: they analysed their model by means of computer simulation and showed by several experiments that a reduced-order model provides results almost as good as the full model.

Marina Paolanti et al. describe an intelligent mechatronic system for indoor navigation assistance in retail environments that minimizes the need for active tagging and does not require metrics maps. The tracking system is based on ultra-wideband technology and the paper contributes a novel Hidden Markov Model for the representation of shoppers’ shelf/category attraction and usual retail scenarios.

Mingming Zhang et al. describe the use of a compliant ankle rehabilitation robot for the treatment of drop foot. The robot has a bio-inspired design by employing four fluidic muscles that mimic skeletal muscles actuating three rotational degrees of freedom. A trajectory tracking controller was developed in joint task space to track the predefined trajectory of the end effector by commanding the individual muscles’ length based on inverse kinematics. The preliminary tests performed on three patients with drop

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foot allowed to assess the effectiveness of the mechatronic system for clinical applications.

Daniele Costa et al. describe the design and fabrication of an ostraciiform swimming robot and its navigation control and guidance system. Compared to other biomimetic vehicles, the proposed architecture has a lower propulsive efficiency but is easier to waterproof and capable to withstand greater pressures. Preliminary tests show that the vehicle is able to perform different missions autonomously once their profiles are received from the base station.

Nahian Rahman et al. present the design of a modular and reconfigurable gripper, which is capable of dexterous manipulation of a plurality of objects. The mechanical concept is first evaluated in a multibody software environment, then a physical prototype has been developed, and the necessary control laws have been derived. Several manipulation experiments are commented in the article.

Finally, we would like to thank all researchers having submitted papers to this special issue and we hope to see many of these contributions published in future issues.

Massimo Callegari is full professor of “Machine Mechanics” at the Università Politecnica delle Marche, Italy, since 2005. He was previously employed in the R&D departments of industries operating in the field of factory automation and then he was researcher in robotics at the University of Genova.

His research fields are mainly the analysis and design of innovative devices and the study of dynamic systems in which the mechanical structure and the control architecture are considered with an integrated mechatronic approach. A specific interest is addressed to the study of robotics, particularly with regard to the parallel kinematic machines. His latest researches are about mini and micro-mechanics and about the use of parallel kinematics machines for performing some technological operations such as single-point incremental forming and friction stir welding.

Primo Zingaretti is Professor of Computer Science at the Università Politecnica delle Marche, Italy.

His main research interests are in artificial intelligence, robotics, intelligent mechatronic systems, computer vision, pattern recognition, image understanding and retrieval, information systems and e-health.

Robotics vision (aerial, ground and underwater autonomous systems) and geographical information systems (GIS) have been the main application areas, with great attention directed to the technological transfer of research results. He is author of over 150 scientific research papers in English, Senior Member of IEEE, Member of ASME, Co-founder of AI²IA and Member of GIRPR-IAPR.