

Editorial

Applied Mathematics for Engineering Problems in Biomechanics and Robotics 2020

Carlos Llopis-Albert ¹, **Francisco Rubio** ¹, **Shouzhen Zeng** ², and **Huchang Liao** ³

¹*Instituto de Ingeniería Mecánica y Biomecánica (I2MB), Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia, Spain*

²*Ningbo University, Ningbo 315211, China*

³*Sichuan University, Chengdu, Sichuan 610065, China*

Correspondence should be addressed to Carlos Llopis-Albert; cllopisa@upvnet.upv.es

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There is a disruptive impact of smart technologies in the 21st century, which is transforming the traditional industry and the healthcare sector into the Industry 5.0 and the Healthcare 5.0. In this sense, biomechanics and robotics are two closely interrelated disciplines that are boosting such transformation. On the one hand, biomechanics is the study of mechanical structures that exist in living beings and the subsequent application of mechanical laws to living structures, especially to the musculoskeletal system of the human body [1, 2]. On the other hand, robotics is the science or branch of technology that covers the analysis, design, construction, and application of robots to carry out human tasks, mainly laborious, repetitive, or dangerous [3–5].

In addition, both disciplines have a marked multidisciplinary character, including physics, mathematics, computing, and biology.

The special issue comprises works related to prostheses, exoskeletons, biomaterials, medical imaging, sensors, assistance, and remote monitoring of healthcare recipients, social robots, digital technologies, sustainable technologies, artificial intelligence, machine learning, nanotechnology, smart health technologies for the diagnosis and treatment of patients, injury prevention, and rehabilitation, sports, assembly line worker safety, product and service quality, ergonomics, production improvement, material handling systems, logistics, management, indoor transportation, vehicle dynamics, kinematics and dynamics of mechanisms, and manufacturing industries.

Therefore, the special issue considers mathematical works related to modeling, simulation, computational mechanics (e.g., multibody dynamics analysis and finite element analysis), optimization problems, statistics, etc.

Finally, the special issue presents 17 high-quality original research articles in the above-mentioned topics, which have been published after a peer review process. The accepted papers encompass a broad spectrum of topics and a brief description of them is given as follows.

In the paper entitled “An Intelligent and Robust Framework towards Anomaly Detection, Medical Diagnosis, and Shortest Path Problems Based on Interval-Valued T-Spherical Fuzzy Information,” Jin et al. presented an application of the interval-valued T-spherical fuzzy set for anomaly detection, medical diagnosis, and shortest path problem.

Zhang et al. set out and discussed the ability to obtain accurate torque information and detect collision information for collaborative robots in the paper “Disturbance Elimination for the Modular Joint Torque Sensor of a Collaborative Robot.”

The paper entitled “Formation Control Algorithm of Agents Based on Earth Mover’s Distance” by Liu et al. introduced a fast formation control method that can be applied to a crowd of unmanned aerial vehicles.

Ruan in the paper entitled “Hesitant Fuzzy Decision-Making Method Based on Correlation Coefficient under Confidence Levels with Application to Multisensor Electronic Reconnaissance” focused on the hesitant fuzzy

decision-making method based on correlation coefficient under confidence levels, which was applied to the multi-attribute decision-making problem in multisensor electronic reconnaissance.

Huang et al. developed a method for ship target detection while ensuring real-time performance, accuracy, and robustness in the paper entitled “Ship Target Detection Based on Improved YOLO Network.”

Dealing with interconnected networks in the paper “Vertex-Disjoint Paths in a 3-Ary n -Cube with Faulty Vertices,” Ma et al. dealt with the disjoint path cover problem, which can accelerate the transmission of large amounts of data by splitting data into disjoint communication paths of multiple vertices, thus avoiding communication congestion and enhancing the robustness of vertex failure and load balancing capability.

In the paper entitled “Prediction of Temperature Field and Thermal Damage of Multilayer Skin Tissues Subjected to Time-Varying Laser Heating and Fluid Cooling by a Semianalytical Method,” Li et al. developed a semianalytical method, based on the separation of variables, to solve the problem of heat transfer in multilayer skin tissues.

Li et al. in the paper “Dynamic Path Planning for Bevel-Tip Flexible Needle Insertion into Soft Tissue Based on a Real-Time Finite Element Model” introduced a novel dynamic path planning methodology for needle steering into the soft tissue based on a real-time finite element model, which provided dynamic deformation information for path planning.

In the paper entitled “Study of Dynamical Behavior and Stability of Iterative Methods for Nonlinear Equation with Applications in Engineering,” Rafiq et al. presented a numerical approach with applications in the fields of robotics in biomechanics.

Vu and Nguyen in the paper “Balancing Control of Two-Wheel Bicycle Problems” built, modeled, and designed a robust controller for self-balancing two-wheel bicycle, while introducing order reduction algorithms for stable and unstable systems.

In the paper entitled “Effect of Surface Roughness during Peristaltic Movement in a Nonuniform Channel,” Shukla et al. addressed the problem of transport of physiological fluids that may be helpful when the inner surface of any biological organ is not fully smooth, for example, endothelium roughness in the coronary artery.

Quynh in the paper entitled “The Fuzzy PI Controller for PMSM’s Speed to Track the Standard Model” developed a fuzzy PI controller to control the speed of a permanent magnet synchronous motor, while its correctness and stability were successfully tested and compared with other kinds of controllers.

In the paper entitled “Sample Entropy Analysis of Horses with and without Lameness at Trot before and after Sedation,” Zhao et al. illustrated that the sample entropy can provide important information about the characteristics of locomotion pattern of the equine gait.

Zhang et al. dealt with the dynamic design and optimization of robot parallel manipulators in the paper “Elastostatic Stiffness Analysis for the US/UPS Parallel

Manipulators,” in which the modeling method was based on screw theory, Castigliano’s theorem, and strain energy.

Dealing with mobile robots in the paper “Flocking Control of Mobile Robots with Obstacle Avoidance Based on Simulated Annealing Algorithm,” Cheng and Wang proposed an algorithm and a motion control law to search the quasi-optimal position of robots in order to reduce the potential functions.

In the paper entitled “On Dynamics of Iterative Techniques for Nonlinear Equation with Applications in Engineering,” Shams et al. constructed and showed the efficiency of an optimal family of iterative methods for finding the single root and then extended this family for determining all the distinct as well as multiple roots of single-variable nonlinear equations simultaneously.

Mao et al. in the paper “A Novel Collision-Free Navigation Approach for Multiple Nonholonomic Robots Based on ORCA and Linear MPC” presented a method for collision avoidance among multiple nonholonomic robots in planar environments, which combines the Optimal Reciprocal Collision Avoidance (ORCA) algorithm and Model Predictive Control (MPC) strategy.

Conflicts of Interest

The Guest Editors declare that they have no conflicts of interest regarding the publication of this special issue.

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Carlos Llopis-Albert
Francisco Rubio
Shouzhen Zeng
Huchang Liao

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