Preface

This Special Issue represents a best paper collection from the successfully organized Women in Engineering workshop and Model-based Healthcare special sessions of the International Conference on Systems, Man, and Cybernetics (SMC), the flagship conference of the IEEE SMC Society held in Budapest from 9-12 October 2016.

SMC 2016 featured a total of 832 technical oral and poster presentations spread over 110 sessions, 3 workshops and 5 tutorials. The Model-based Healthcare I-II sessions and the Women in Engineering workshop involved 24 papers with high popularity within the conference. The current special issue titled "*The importance of modeling, analysis and control in both industrial and clinical applications*" includes the extended versions of the 14 best papers of the mentioned SMC 2016 special events.

The papers are supported by the *IEEE SMC Cyber-Medical Systems Technical Committee*. Nowadays, medical technological advancement and devices are firmly associated with engineering achievements. Therefore, intelligent and model-based applications are needed, robust enough to generalize its healthcare target, but individualized as well to personalize its applicability. In this way it could increase the quality of life of the patients, optimize therapy and hence, reduce treatment costs. This special issue provides adequate up-to-date applications of intelligent, model-based healthcare problems covering diabetes, cancer, cardiovascular systems and infection control.

The topic of control system plays a vital role in engineering and technology. For successful design of any physical control system modeling, analysis and simulation are important. Control strategies such as adaptive control, robust control, model based predictive control and fractional order control have brought significant improvements in the area of process control. These methods are of interest in applications dealing with uncertainties, constraints, memory effect, time delay, etc. In this special issue the importance and capabilities of control techniques in several areas of research will be provided to the community.

Artificial pancreas represents one of the most important biomedical engineering challenges of the last 15 years. The "closing the loop" problem in diabetes has many unsolved issues and is mainly discussed for type 1 (insulin dependent) diabetes patients. Alessandro Borri and his colleagues from Italy present in silico results for type 2 (non-insulin dependents) diabetic patients. The controller is developed based on an observer-based method without any information about the time course of insulinemia.

Fractional calculus is a relatively new topic in control and biomedical engineering. Dana Copot and her colleagues from Belgium compare classical impedance model with a fractional order one to estimate glucose concentrations. The clear benefit of

capturing the dynamics of the measured impedance is demonstrated by the use of the fractional order impedance model.

The papers of the Physiological Controls Research Group of Óbuda University Hungary authored by Johanna Sápi and her colleagues, and by Tamás Ferenci and his colleagues present the latest results of the Tamed Cancer ERC StG grant. In the first paper the effectiveness of different drug delivery protocols is evaluated using in silico simulations. The results are compared with discrete-time controller-based treatments containing state feedback, setpoint control, actual state observer and load estimation. On the other hand, the paper of Tamás Ferenci et al. focuses on modeling the tumor growth under the targeted molecular therapy of antiangiogenesis with mixed-effect models. It is demonstrated that exponential model can be estimated in a robust manner, both at individual and at population-level by mixed effect model, while sigmoid-like growth curves are almost impossible to be estimated.

The work of Xuan Chen and her colleagues from Singapore is an extended version of their SMC paper awarded with the SMC 2016 Best Student Paper Award. A novel automated framework is presented to address the significant, but challenging task of multi-label brain tumor segmentation. The framework has clear advantages on performance and processing time compared to previous state-of-the-art approaches.

György Eigner's paper from Hungary introduces a novel controller design approach dealing with the control of affine Linear Parameter Varying systems using the abstract mathematical properties of the LPV parameter space and classical state-feedback design. The method is demonstrated on a biomedical problem, diabetes mellitus.

Tun Wen Pai and his colleagues from Taiwan present their results in chronic heart failure clinical classification using Internet-of-Medical-Things devices and cloud computing technologies. The developed system can be customized on heart failure patients and the system is validated on several testing cases showing excellent performance and low cost.

Róbert Pethes and his colleagues from Hungary discuss infectious hospital agents. A simulation framework based on stochastic events is able to model wide range of infection spreading scenarios in the hospital environment.

Finally, the last biomedical related paper is connected to Rita Fleiner and her colleagues from Hungary and discusses indoor navigation possibilities in medical facilities for motion disabled persons. Two ontologies iLOC and hLOC are presented for supporting accessible free-text type indoor navigation in hospitals.

The remaining papers are focusing on industrial control applications. Xiaoyu Tan and his colleagues from Singapore present a cognitive engine based on the hybrid architecture for robot-assisted radio-frequency ablation system. It was demonstrated by ex-vivo experiments that the created engine provides surgical

execution procedures correctly and it can be modified for other robot-assisted applications as well.

Dániel András Drexler's paper from Hungary presents a closed-loop inverse kinematics algorithm to numerically approximate the solution of the inverse kinematics problem, a central problem of robotics. Simulations results show that second-order methods give the best results, but decreases stability margin. The latter is analyzed on different numerical integration techniques.

Eva Dulf and her colleagues' paper from Romania discuss robust fractional order controllers for distributed systems using particle swarm optimization. Results are demonstrated on the complex chemical process of isotope separation columns cascade.

Carla Pinto from Portugal presents her paper in asymmetrically coupled fractional neurons. A fractional order model is proposed on the dynamics of two asymmetrically coupled Hodgkin-Huxley equations.

Silviu Folea and his colleagues from Romania and Belgium remains as well on the fractional order control topic. The paper uses a smart beam as a simulator for the airplane wings and a fractional order PD controller is designed for active vibration mitigation. The experimental results demonstrate that the designed controller can significantly improve the vibration suppression in smart beams.

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