Editorial

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Biographical notes: Faïçal Mnif received his Engineering Degree in Electrical Engineering from the École Nationale d'Ingénieurs de Sfax (Tunisia) in 1988, an MSc and a PhD in Control and Robotics in 1991 and 1997 from the Ecole Polytechnique de Montreal (Canada). He is an Associate Professor of Control Engineering and Robotics at the National Institute of Applied Sciences and Technology (Tunisia). Currently, he is on leave to Sultan Qaboos University (Oman) at the Department of Electrical and Computer Engineering. He is the Member of the research unit on Mechatronics and Autonomous systems (MECA) in ENIS (Tunisia). His main research interests include the control of mechanical systems and robust and non-linear control theory and applications.

Nabil Derbel is the general chairman of the multiconferences SSD. He received his Engineering Diploma from the Ecole Nationale d'Ingénieurs de Sfax in 1986, the Diplôme d'Etudes Approfondies in Automatic control from the Institut National des Sciences Appliquées de Toulouse in 1986, the Doctorat d'Université degree from the Laboratoire d'Automatique et d'Analyse des Systèmes de Toulouse in 1989 and the Doctorat d'Etat degree from the Ecole Nationale d'Ingénieurs de Tunis in 1997. He joined the Tunisian University since 1989, where he held different position involved in research and education. Currently, he is a Full Professor of Automatic Control at the Ecole Nationale d'Ingénieurs de Sfax. His current interests include optimal control, complex systems, fuzzy logic, neural networks and genetic algorithms. He is the author and the co-author of more than 30 papers published in international journals and of more than 200 papers published in international conferences. He is the Head of the two Research Units: Mechatronics and Autonomous systems (MECA) and Computers, Imaging and Electronic Systems (CIELS).

1 Introduction

In 2007, the biannual International Multiconference on Signal Systems and Devices (SSD'2007) was held in Hammamet, Tunisia, 19–22 March, with about 500 participants. The conference was organised jointly by the National Engineering School of Sfax (Tunisia) and the University of the Bundeswehr Munich (Germany). The Multiconference ran four parallel technical conferences: systems analysis and automatic control, power electrical systems, communication and signal processing and sensors, circuits and instrumentation systems. Four keynote talks and four plenary sessions were held within the event. The SSD'07 was technically sponsored by IEEE Circuit and Systems Society (CAS).

SSD'07 secretariat received 510 submissions from 43 countries: Algeria, Argentina, Belgium, Canada, China, Egypt, France, Germany, Greece, India, Indonesia, Iran, Iraq, Ireland, Italy, Japan, Jordan, Korea, Kuwait, KSA, Lebanon, Lithuania, Libya, Malaysia, Morocco, Oman, Pakistan, Poland, Portugal, Qatar, Romania, Russia, Sarajevo, Syria, Singapore, Spain, Sweden, Tunisia, UAE, UK, Ukraine, USA and Yemen. Only 383 papers were accepted.

2 Issue contents

Authors of most innovative papers dealing with modelling, identification and control theories and techniques were invited to submit an extended version of their works for possible publication in this Special Issue. The eight papers included in this issue have passed the rigorous peer-reviewing selection process. The contents of the papers are briefly described as follows.

Chemical process sliding mode control, co-authored by M. Sekher, M. M'Saad, M. Farza and O. Gehan. The temperature control involved in chemical reactors has

shown to be of fundamental importance from product quality and cost points of view. This paper presents a likely sliding mode control approach to deal with the temperature servo problem in exothermic stirred tank batch reactors. Two design features are worth to be emphasised. Firstly, an engineering control design framework is developed in the sliding mode control spirit. This involves a design function satisfying an adequate reachability condition and allows to incorporate a filtered integral action into the design for free offset performance considerations. Secondly, a high gain observer providing an accurate estimation of the reaction heat is used to improve the control performances while monitoring the chemical reactor operation. The control as well as the monitoring features of the proposed approach are illustrated in a realistic simulation framework involving an exothermic stirred tank reactor.

Sliding mode-based synchronisation and control of chaotic systems with parametric uncertainties, co-authored by Aida Fourati, Moez Feki and Nabil Derbel. This paper proposes a result on controlling chaos using the sliding mode control method. The authors show that for the class of chaotic systems that can be stabilised using a smooth feedback controller, a sliding surface can be easily constructed based on the Lyapunov theory. Moreover, it is shown that if the states are confined to the sliding surface, then the originally chaotic trajectories will slide along a stable manifold towards the equilibrium. In addition to stabilisation, the authors show that the proposed controller can also lead to synchronisation of two chaotic systems when the problem is regarded as trajectory tracking. They also prove that the proposed controller becomes robust to parametric uncertainties by increasing the gain. Besides, the unwanted chattering phenomenon can be reduced by adaptively tuning the sliding gain. All these results are confirmed through numerical simulations on a set of jerk systems.

Fuzzy rule base reduction via singular value decomposition, co-authored by Hiyem Frikha-Djemel and Nabil Derbel: This paper deals with a fuzzy rule base reduction via Singular Value Decomposition (SVD). The method consists of forming a rule consequents matrix, applying SVD procedure and then keeping only the larger singular values. Hence, the dimension of the reduced rule base depends on the number of the retained singular values. New membership functions are obtained by generating linear combinations of the original ones. This approach is applicable regardless of the input variable's number, the inference paradigm and the shape of the initial membership functions. In this work, the SVD reduction is applied in the case of rule base where all fuzzy rules are defined and the case of rule set including some missing rules. Fuzzy logic controllers exploiting these rule bases are considered to control an inverted pendulum.

Neural network augmented backstepping control for an induction machine, co-authored by Mohammed Belkheiri and Fares Boudjema. A new control approach is proposed to address the tracking problem of an induction machine based on a modified Field-Oriented Control (FOC) method. In this approach, one relies first on a partially known model of the system to be controlled using a backstepping control strategy. The obtained controller is then augmented by an online neural network that serves as an approximator for the neglected dynamics and modelling errors. The proposed approach is systematic, and exploits the known non-linear dynamics to derive the stepwise virtual stabilising control laws. At the final step, an augmented Lyapunov function is introduced to derive the adaptation laws of the network weights. The effectiveness of the proposed controller is demonstrated through computer simulation.

Identification of the GMS friction model based on a robust adaptive observer, co-authored by Said Grami and Pascal Bigras. The identification of the Generalised Maxwell Slip (GMS) friction model is presented in this paper. An approximation is proposed to make the friction model linear over its unknown parameters. A bounded disturbance is used to model the approximation error. A robust observer is then applied to estimate the unknown parameters in spite of the approximation error. The approximated friction model is filtered to render it appropriate for use by the observer. Simulation results are presented to prove the efficiency of the observer in estimating the frictional force even though the model has been approximated.

Multilayer perceptron training using an evolutionary algorithm, co-authored by R. El Hamdi, M. Njah and M. Chtourou. It is shown, through a considerably large literature review, that combinations of Artificial Neural Networks (ANNs) and Evolutionary Algorithms (EAs) can lead to significantly better intelligent systems than relying on ANNs or EAs alone. Evolution can be introduced into ANNs at many different levels. This paper focuses on the evolution of connection weights, which provides a global approach to connection weight training especially when gradient information of the error function is difficult or costly obtained. Due to the simplicity and generality of the evolution and the fact that gradient-based training algorithms often have to be run multiple times in order to avoid being trapped in a poor local optimum, the evolutionary approach is quite competitive. This paper takes a step in that direction by introducing an evolutionary algorithm (Perceptron Learning using Genetic (PLG) algorithms) for Multi-Layer Perceptron (MLP) learning that gets results comparable to or better than backpropagation.

Backward iteration approaches for the stability domain estimation of discrete non-linear polynomial systems, co-authored by Anis Bacha, Houssem Jerbi and Naceur Benhadj Braiek. This paper deals with two evolutionary algorithms for calculating the asymptotic stability region for discrete non-linear polynomial systems. These algorithms, in fact, rest on two new approaches of inverting discrete direct polynomial state equation. Based on some topological considerations, the systematic computational algorithms are then applied on the second order polynomial model of a synchronous generator power system. Hence, a comparative study is presented to illustrate the benefits of the proposed algorithms so as to maximise the region of asymptotic stability.

On an internal multimodel control for non-linear systems: a comparative study, co-authored by

Dhaou Soudani, Mongi Naceur, Kamel Ben Saad and Mohamed Benrejeb. An approach of internal model controller synthesis for non-linear systems is proposed in this paper. This approach is based on the multimodel modelling of non-linear systems and the realisation of a specific inverse of each model. The inversion of each model is necessary in the internal model controller design. A comparative study is presented between two structures of internal multimodel controller for non-linear control system based on two different fusion methods. The first one is based on the switching methods and the second one is based on the residues techniques. The case of a non-linear system is presented to show the effectiveness of these control structures and to compare these structures of internal multimodel control of this non-linear system.