PREFACE

Special section on
Issues in Parameter Identification and Control

The 13th European Workshop on *Advanced Control and Diagnosis (ACD 2016)* took place in Lille, France, in November 2016. The objective of the workshop is to bring together senior and junior academics and engineers from diverse fields of automatic control, fault detection, and signal processing. The workshop provides an opportunity for researchers and developers to present their recent theoretical developments, practical applications, or even open problems. Given the success of this workshop, a special section of the *International Journal of Applied Mathematics and Computer Science* devoted to selected issues in parameter identification and control has been prepared.

Parameter identification, control and diagnosis are very active fields of research in applied sciences, with a fast growing literature. Parameter identification problems deal with the reconstruction of unknown functions or geometric objects appearing as parameters. Parameter identification is a common area of research that focuses on determining the system parameters as the conditions of the system change. Therefore, it is advantageous to employ data-driven identification and control methods that can use the process data efficiently while maintaining, as much as possible, the existing control structure.

The workshop had attracted almost 100 contributions, of which 12 were selected and extended for this special section. Through a laborious reviewing process, 8 papers have been accepted for publication. I believe that the communications are of very good quality. Hereafter is a brief description of the content of the selected papers.

The first paper, entitled *Minimal positive realizations of linear continuous-time fractional descriptor systems: Two cases of an input-output digraph structure*, by K.A. Markowski, deals with the computation of a set of a minimal positive realization of a given transfer function of linear fractional continuous-time descriptor systems. The proposed method is based on digraph theory. Two cases of a possible input-output digraph structure are investigated and discussed. It should be noted that a digraph-mask was introduced and used for the first time to solve a minimal positive realization problem. For the presented method, an algorithm was also constructed. The proposed solution allows minimal digraph construction for any one-dimensional fractional positive system. The proposed method is discussed and illustrated in detail with some numerical examples.

The second paper, entitled *A geometric approach to structural model matching by output feedback in linear impulsive systems*, by E. Zattoni, provides a complete characterization of the problem solvability for structural model matching by output feedback in linear impulsive systems with nonuniformly spaced state jumps. Namely, given a linear impulsive plant and a linear impulsive model, the problem consists in finding a linear impulsive compensator that achieves exact matching between the respective forced responses of the linear impulsive plant and of the linear impulsive model, by means of dynamic feedback of the plant output, for all the admissible input functions and for all the admissible sequences of jump times The solution of the stated problem is achieved by reducing it to an equivalent problem of structural disturbance decoupling by dynamic feedforward. Indeed, the latter problem is formulated for the so-called extended linear impulsive system, which consists of a suitable connection between the given plant and a modified model. A necessary and sufficient condition for the solution of the structural disturbance decoupling problem is provided.

The third paper, entitled *Distributed scheduling of measurements in a sensor network for parameter estimation of spatio-temporal systems*, by M. Patan and D. Kowalów, deals with the development of a distributed algorithm for optimal node activation in a sensor network whose measurements are used for parameter estimation of the underlying distributed parameter system. Given a fixed partition of the observation horizon into a finite number of consecutive intervals, the problem under consideration is to optimize the percentage of the total number of observations spent at given sensor nodes in such a way as to maximize the accuracy of system parameter estimates. To achieve this, the determinant of the Fisher information matrix related to the covariance matrix of the parameter estimates is used as the qualitative design criterion (the so-called D-optimality). The proposed approach converts the measurement scheduling problem to a convex optimization one, in which the sensor locations are given *a priori* and the aim is to determine the associated weights, which quantify the contributions of individual gaged sites to the total measurement plan. Then, adopting a pairwise communication schemes, a fully distributed procedure for calculating the percentage of observations spent at given sensor locations is developed, which is a major novelty here. Another significant contribution of this work consists in derivation of necessary and sufficient optimality conditions. As a result, a simple and effective computational scheme is obtained which can be implemented without resorting to sophisticated numerical software.

The fourth paper, entitled *An adaptive observer design approach for a class of discrete-time nonlinear systems*, by K. Srinivasarengan, J. Ragot, C. Aubrun and D. Maquin, discusses the problem of joint estimation of states and some constant parameters for a class of nonlinear discrete time systems. It contains systems that could be transformed into a quasi-LPV (linear parameter varying) polytopic model in Takagi–Sugeno (T–S) form. Such systems could have unmeasured premise variables, a case usually overlooked in the observer design literature. The authors assert that for such systems in discrete-time, the current literature lacks design strategies for joint state and parameter estimation. To achieve this, they adapt the existing literature for continuous-time linear systems for joint state and time varying parameter estimation. We first develop the discrete-time version of this result for linear systems. The Lyapunov approach is used to illustrate stability, and bounds for the estimation error are obtained through the bounded real lemma.

The fifth paper, entitled *Active fault tolerance control of a wind turbine system using an unknown input observer with an actuator fault*, by S. Li, H. Wang, A. Aitouche, Y. Tian and N. Christov, proposes a fault tolerant control scheme based an unknown input observer for a wind turbine system subject to actuator faults and disturbance. The authors provide an unknown input observer for state estimation, and fault detection using a linear parameter varying model is developed. By solving linear matrix inequalities (LMIs) and linear matrix equalities (LMEs), the gains of the unknown input observer are obtained. The convergence of the unknown input observer is also analyzed with Lyapunov theory. Secondly, using fault estimation, an active fault tolerant controller is applied to a wind turbine system. Finally, a simulation of a wind turbine benchmark with an actuator fault is tested for the proposed method.

The sixth paper, entitled *H_-/H_∞ fault detection observer design for a polytopic LPV system using the relative degree*, by M. Zhou, M. Rodrigues, Y. Shen and D. Theilliol, proposes an H_-/H_∞ fault detection observer method by using generalized output for a class of polytopic linear parameter-varying (LPV) systems. The main contribution of this paper is that, with the aid of the relative degree of output, a new output vector is generated by gathering the original output and its time derivative, and it is feasible to consider the H_- actuator fault sensitivity in the entire frequency for the new system. In order to improve the actuator and sensor fault sensitivity as well as guarantee robustness against disturbances, simultaneously, an H_-/H_∞ fault detection observer is designed for the new LPV polytopic system.

The seventh paper, entitled *Multi-layer health-aware economic predictive control of a pasteurization pilot plant*, by F. Karimi-Pour, V. Puig and C. Ocampo-Martinez, deals with two different health-aware economic predictive control strategies that aim at minimizing the damage of components in a pasteurization plant. The damage is assessed with the rainflow-counting algorithm that allows estimating the components' fatigue. A simplified model that characterizes the health of the system is developed and integrated into the predictive controller. The overall control objective is modified by adding an extra criterion that takes into account the accumulated damage. The first strategy is a single-layer predictive controller with integral action to eliminate the steady-state error that appears when adding the extra criterion. In order to achieve the best minimal accumulated damage and operational costs, the single-layer approach is improved with a multi-layer control scheme, where the solution of the dynamic optimization problem is obtained from the model in two different time scales.

The last paper, entitled *Robust stabilization using a sampled-data strategy of uncertain neutral state-delayed systems subject to input limitations*, by N. El Fezazi, F. El Haoussi, E.H. Tissir, T. Alvarez and F. Tadeo, concerns the problem of stabilization of neutral systems with state delay, subject to uncertainty and input limitations in magnitude. The authors propose a solution based on simultaneously characterizing a set of stabilizing controllers and the associated admissible initial conditions, thanks to using a free weighting matrix approach. From this mathematical characterization, state feedback gains that ensure a large set of admissible initial conditions are calculated by solving an optimization problem with LMI constraints.

I would like to thank a great number of individuals who helped and supported me in preparing this special section, and I especially wish to express my gratitude to the reviewers who assisted me in the reviewing process, providing insightful feedback that helped the authors to significantly improve their manuscripts.

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