Editorial

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The Third International Conference on Automation, Control, Engineering and Computer Science (ACECS-2016) was conducted during March 20–22, 2016 at Hammamet, Tunisia. The conference provided an excellent research forum for professionals, academics, and researchers to share knowledge and results on automation, control, engineering, computer science and information technology. Broad areas of ACECS-2016 were classified as computer science and IT, signal processing and communication, robotics, control and instrumentation, engineering and automation, and engineering management.

In practice, the implementation of control input is usually faced with the problem of nonlinearity in control input due to non-ideal characteristics of actuators used in physical implementations. Adaptive control theory for nonlinear systems has attracted much attention during the past two decades. Recently, adaptive control based on universal approximations such as fuzzy logic systems, RBF neural networks or fuzzy-neural networks have been considered extensively in the control problems of complex and ill-defined nonlinear systems in the presence of incomplete knowledge of the plant.

Observer-based robust adaptive universal approximation control schemes are very useful for tackling the problem of robust stability and the tracking control for a class of uncertain nonlinear SISO systems and MIMO systems with or without time delays. Also, adaptive universal approximation control schemes have impact for a class of nonlinear systems with dead-zone and multiple time-delays based on dynamic surface control (DSC) technique.

In this part 2 of the special issue of the *International Journal of Automation and Control* (*IJAAC*), we are delighted to select seven research articles reporting on recent advances and applications in observer-based fuzzy, neural and adaptive control. This special issue contains extended papers of ACECS-2016 Conference as well as research articles of experts and research scholars.

It is hoped that this special issue will provide a useful reference for informing recently developed technologies in intelligent control and engineering informatics. The contents of the selected seven articles are described briefly as follows:

The paper titled 'Design of a proportional integral observer based on sliding mode principle for uncertain Takagi-Sugeno fuzzy systems: applications to a turbo-reactor' by Ilyes Elleuch, Atef khedher and Kamel Ben Othman deals with the problem of state and fault estimation for systems described by Takagi-Sugeno (T-S) fuzzy systems. The state and fault estimation is made using a proportional integral (PI) observer based on the sliding mode principle. Only sensor faults are considered in this work. In order to estimate this kind of fault, a particulate mathematical transformation is used. The application of this mathematical transformation to the initial system output enables an augmented system where the initial sensor fault appears as an unknown input. An adaptive mathematical form is used for the sign function to facilitate the determination of the proportional gains of the conceived observer. The observer convergence conditions are formulated in the form of linear matrix inequalities (LMIs) allowing computing the observer gains and the Lyapunov theory is used to guarantee the system stability with faults. The proposed PI sliding mode observer is applied to turbo-reactor showing the efficiency of the fault and state estimation.

The paper titled 'Sliding surface-based obstacle avoidance for second order multi-agent systems' by Asma Essghaier, Lotfi Beji and Azgal Abichou studies formation keeping along with obstacle avoidance for second-order multi-agent systems. First, the flexible virtual structure (FVS) approach, used to model the communication topology between the agents of the formation, is recalled and relationship with graph theory-based communication exchange to achieve consensus is established. Second, using the regulation function (RF) which permits to change the behaviour of the system's solution without affecting convergence, obstacle avoidance is investigated for one agent (leader/co-leader) of the formation. In particular, RF has been used to ensure obstacle avoidance for first order agents and is extended in this work for second order agents. Relationship between the dynamic agent and a sliding surface with first order kinematics is established and condition on the sliding surface parameter is developed to ensure obstacle avoidance. Also new shapes of the obstacle are considered, viz. square and rhombus. Finally, in order to perform coordinated obstacle avoidance of a multi-agent system when only a subset of agents namely co-leaders, selected from the boarder, has obstacle information, one defines control laws which permit to control motions of the remaining formation agents.

The paper titled 'Synchronisation control for ships in underway replenishment based on dynamic surface control' by Yongchao Liu, Jialu Du and Xin Hu develops a nonlinear

synchronisation control law for the supply ship in the underway replenishment under environmental disturbances by incorporating a robust term based on signum function into the DSC technique. It is proved that the designed synchronisation control law can force the supply ship to track the virtual trajectory with arbitrarily small errors, while guaranteeing that all signals in the synchronisation closed-loop control system are uniformly ultimately bounded so that synchronisation motion control is realised between two ships. Simulation results on a supply ship illustrate the effectiveness of the proposed synchronisation control law.

The paper titled 'Fuzzy sliding mode control for three-tank system based on linear matrix inequality' by El Mehdi Mellouli, Mohammed Alfidi and Ismail Boumhidi details a novel method based on fuzzy sliding mode (FSM) and LMI to design a new robust adaptive fuzzy control for a perturbed multi-input multi-output (MIMO) three tank system with unknown dynamics and without chattering problem. The proposed method uses the adaptive fuzzy system T-S to approximate the unknown dynamics model of the three tank system which is considered a very complicated system due to the high nonlinearity and cross coupling. Moreover, to overcome the external disturbance and the fuzzy approximation errors due to the modelling system, an auxiliary control term-based sliding mode is incorporated in the control law. LMI is used to determine the parameters of the dynamic compensator which is added to improve more performance of the closed-loop system in the sliding mode. The stability and robustness of the proposed method are proved using Lyapnov stability theory. Simulation results are shown to demonstrate the tracking performance of the proposed approach.

The paper titled 'Adaptive iterative learning control of nonlinearly parameterised strict feedback systems with input saturation' by Hocine Benslimane, Abdesselem Boulkroune and Hachemi Chekireb proposes a new adaptive iterative learning control scheme to deal with nonlinearly parameterised strict feedback systems under alignment condition in the presence of input saturation constraint. The learning controller is designed by using the command filtered adaptive backstepping design procedure. The nonlinearly connected parameters are separated from the local Lipschitz continuous nonlinear functions and then learning laws are designed in iteration domain. To overcome the problem of input saturation, an auxiliary system is constructed with the same order as that of the systems under consideration. It is proved that the proposed control scheme can guarantee that all signals of the resulting closed-loop system remain bounded, and the tracking error converges to zero as the iteration number goes to infinity. A simulation example is depicted to illustrate the effectiveness of the proposed adaptive control scheme.

The paper titled 'Robust fuzzy fault tolerant control for induction motor subject to sensor fault' by Habib Ben Zina, Moez Allouche, Maha Bouattour, Mansour Souissi, Mohamed Chaabane and Larbi Chrifi-Alaoui presents a strategy of fault tolerant control (FTC) to keep the vector controlled induction motor (IM). The aim is to minimise the effect of the sensor fault and the parametric uncertainties. First, a fuzzy proportional multiple integral observer (PMIO) is used to estimate simultaneously the system state and the sensor fault.

Secondly, a feedback robust state tracking control is synthesised to guarantee then control performances. The proposed controller is based on a T-S reference model to specify the desired trajectory. The performances of the trajectory tracking are analysed using the Lyapunov theory and the L_2 optimisation. The gains of the observer and

controller are obtained by solving a set of LMIs constraint. Finally, simulation results are given to show the effectiveness of the proposed control scheme.

The paper titled 'Design and analysis of BFOA optimised PID controller with derivative filter for frequency regulation in distributed generation system' by Tulasichandra Sekhar Gorripotu, Darapureddi Vijaya Kumar, Manmadha Kumar Boddepalli and Ramana Pilla proposes a bacteria foraging optimisation algorithm (BFOA)-based proportional integral derivative controller with derivative filter (PIDF) for frequency regulation of multi source hybrid power system. Initially, a two area unequal area power system with PIDF controllers are considered. The area-1 comprises of reheat thermal power system incorporated with distributed generation (DG) system comprising of wind turbine generators (WTGs), diesel engine generators (DEGs), fuel cells (FCs), aqua-electrolyser (AE), ultra capacitor (UC) and battery energy storage system (BESS). The area-2 comprises of hydro-thermal power system. The gains of the PID controller with derivative filter are optimised by using integral time multiply absolute error (ITAE) criterion. The superiority of PIDF controller is demonstrated by comparing the dynamic responses with integral derivative (ID) and PI controllers. The simulation results show that the performance of dynamic responses with PIDF controller is superior to others. Further, robustness analysis is performed by varying the system parameters and wind power variations. The simulation results are illustrates the effectiveness of the controller proposed in this work.

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