Editorial

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Biographical notes: Zi-Jiang Yang received his DrEng degree from Kyushu University, Fukuoka, Japan, in 1992. From 1996 to 2000, he was an Associate Professor with the Faculty of Computer Engineering and System Science, Kyushu Institute of Technology, Fukuoka. He is currently an Associate Professor with the Department of Electrical and Electronic Systems Engineering, Graduate School of Information Science and Electrical Engineering, Kyushu University. His research interests include system identification, related signal processing, soft computing, and motion control.

Welcome to the special issue on recent advances in applications of adaptive and robust control techniques. In the last several decades, research on the adaptive and robust control theories or techniques for uncertain systems has been carried out by many researchers and engineers in different fields. This is due to that almost all the practical automatic control systems operate in highly uncertain environments. The task of a reliable control system is to ensure the achievement of the prescribed goals and guarantee good performance in the presence of uncertainties. Adaptive and robust control or their integrations are considered to be one of the most typical techniques to deal with the uncertainties. However, there has been a pain for the adaptive or robust control community that despite of considerable amount of research activities in these fields, the adaptive or robust control techniques are still far from gaining popularity in the industrial side.

This special issue, however, is focused on recent advances in applications of adaptive and robust control techniques. It contains eight papers that provide a wide variety of practical applications or related theoretical developments of adaptive control and robust control. The main contents of the papers are briefed as follows.

'Thermal MIMO model and decoupling PID control', by Matuki, Hamane, Hiroki and Miyazaki. This paper presents a MIMO thermal model and a design procedure of decoupled PID controller parameters for a commercialised temperature controller. To ensure robustness in the presence of uncertainty, a robust observer based on the H-infinity design or mu synthesis technique is also presented. Experiment results are provided to verify the merits of the proposed techniques.

'A fuzzy optimal controller for the mechatronic system with non-smooth non-linearities', by Zhao, Xie and Hong. The authors propose an optimal controller design procedure for a system with time varying and non-smooth non-linearities described by Takagi-Sugeno fuzzy model. The controller design is performed as an optimisation problem subject to linear matrix inequalities (LMIs) constraints. The controller is applied to a harmonic drive system which is subject to the non-linear and temperature varying friction. The performance of the controller is verified through the simulation results.

'Frequency estimation with an LMI-based adaptive update law', by Matsuo, Adachi and Suemitsu. A new method of online frequency estimator is proposed, which is potentially applicable to practical systems, by using an adaptive observer. The adaptive law is derived by the LMI techniques and the stability of the error system in the presence of bounded disturbances is theoretically proved. The performance is investigated by numerical simulations.

'Development of meal assistance orthosis for disabled persons using EOG signal and dish image', by Goto, Nakamura and Sugi. A meal assistance orthosis is developed for elderly and/or disabled persons who have partly or completely lost the ability of moving their upper limbs by themselves independently. EOG signal processing, image processing and position feedback control techniques are applied to construct the whole system. Experimental results are also provided.

'A robust adaptive H-infinity control for robotic manipulators with input torque uncertainties', by Sato, Nakashima and Tsuruta. This paper proposes an adaptive control method for robotic manipulators with input torque uncertainties. The controller can attenuate not only the external input torque disturbances but also estimation errors of unknown parameters in the notion of H-infinity control performance. Simulation and experimental results are given to illustrate the effectiveness of the proposed method.

'Adaptive active suspension controller achieving the best ride comfort at any specified location on vehicles with parameter uncertainties', by Oya, Tsuchida, Wang and Taira. In this paper, an adaptive active suspension control

scheme is developed to optimise the ride comfort at any specified location on vehicle body even if the vehicle parameters are unknown. A robust adaptive active suspension controller is proposed and numerical simulations are provided to show the advantage of the proposed controller.

'Torque balancing control in ignition event based scale for multi-cylinder SI engines', by Li, Liu, Shen and Kako. This paper studies the torque balancing problem for multi-cylinder SI engines. According to coupling characteristic in torque generation between cylinders, a simple second order ARMA model is established and a model predictive controller is designed based on the model. The performance of the proposed controller is demonstrated by simulations performed on a six-cylinder engine simulator with physical background.

'A new neural networks based adaptive model predictive control for unknown multiple variable non-linear systems', by Sha. An adaptive model predictive control (AMPC) based on neural networks for unknown MIMO non-linear systems is proposed. A new recursive second order online learning algorithm with a forgetting factor is developed for training of the neural network model that approximates the unknown non-linear system. And a new cost function based on the system output error and control inputs with a forgetting factor is adopted. The performance of the proposed controller algorithm is demonstrated by simulation experiments to a MIMO non-linear system.

We wish that the readers can benefit from the rich collections of the papers included in this special issue and can further investigate the theories and applications of the methods presented to other practical systems.

We would like to thank the *International Journal of Advanced Mechatronic Systems* for giving us the opportunity to serve as the guest editors for the special issue. Moreover, the reviewers have done an excellent job despite of the tight time schedule and this is gratefully acknowledged. Finally, we would also like to thank the authors for their contributions.