Editorial

Hansheng Wu

Department of Information Science,
Prefectural University of Hiroshima,
Hiroshima City, Hiroshima, 734-8558, Japan
E-mail: hansheng@pu-hiroshima.ac.jp

Biographical notes: Hansheng Wu received his PhD in Information Engineering from Hiroshima University, Japan in 1989. From April 1993 to March 1996, he was an Associate Professor in the Faculty of Integrated Arts and Sciences, Hiroshima University. In April 1996, he joined the Department of Information Science, Hiroshima Prefectural University, which was renamed Prefectural University of Hiroshima in 2005, where he has been a professor since April 1998. His research interests include optimal control, dynamical games, large-scale systems, robust control, adaptive control, and their applications.

This is the special issue composed of selected papers from the 2012 International Conference on Advanced Mechatronic Systems (ICAMechS 2012). This conference was held at the Tokyo University of Agriculture and Technology, Tokyo, Japan, September 18–21, 2012. In this special issue, seven technical contributions on the advanced control theory and its applications to some practical control systems, presented during the conference, were selected for publication. The contents of these studies are briefly described as follows.

In the paper entitled 'Oscillation criteria of solutions for a new class of impulsive parabolic equations with delay' by Wanli Yang, Junhong Liu, Suwen Zheng and Lifeng Li, the stability problem has been considered for a class of non-linear impulsive distributed systems with time-delay. Firstly, the forced oscillation of systems of impulsive parabolic differential equations with one delay is discussed, and by using impulsive delay differential inequalities, some sufficient conditions are derived for the forced oscillation of the solutions of the systems. Moreover, the results are also extended to a class of the systems of impulsive parabolic differential equations with two delays.

In the paper entitled 'Design of a multirate PD control system for improvement in the steady-state intersample response' by Takao Sato, Nozomu Araki and Yasuo Konishi, a new design method is presented for a multirate system, in which the continuous-time plant is controlled by updating the discrete-time control input, and in which the sampling interval of the plant output is an integer multiple of the hold interval of the control input. It is well known that in the multirate system, the intersample output might oscillate even if the sample output converges to its reference input, and such a problem should be considered. In the related control literature, the intersample oscillation may eliminated using the integral compensation, hence a multirate PID control law has been designed based on multirate generalised predictive control. The integral compensation works well on the elimination of the intersample ripples in the multirate system, but the phase lag is caused in entire bandwidth by the integral compensation. Therefore, the use of the integral compensation may deteriorate the stable margin and the transient response. In this paper, a new design method has been proposed for eliminating the intersample ripples without the integral compensation. In the proposed method, a multirate proportional-derivative (PD) control law is extended by introducing a design parameter which can be designed independently of the sample response. Thus, by employing the proposed method, the intersample response can be improved independently of the sample response because the introduced design parameter is selected such that the steady-state intersample ripples can be eliminated.

In the paper entitled 'Design and experimental evaluation of a data-oriented multivariable PID controller' by Shin Wakitani and Toru Yamamoto, the design method of the multivariable Generalised Minimum Variance PID control system has been considered. It is well known that for a PID control system, the control performance strongly depends on PID parameters. Although, some schemes for tuning PID parameters have been proposed, these schemes require system parameters which are estimated by system identification in order to calculate PID parameters. Moreover, most process systems are multivariable systems which have interference of each respective input. In addition, the data-oriented controller design schemes represented by VRFT or FRIT have received much attention in the last few years. These methods can calculate control parameters using closed loop data, and are expected to reduce computational costs. However, few efforts are made to extend these methods to MIMO control systems because of its complexity. In this paper, a design method is proposed whereby a class of data-oriented multivariable PID controller using closed loop data is proposed. In the light of the proposed method, full matrices PID parameters which suppress mutual interference can be calculated based on the implicit generalised minimum variance control (GMVC). Furthermore, the control performance can be suitably adjusted by user-specified parameters. Finally, the effectiveness of the proposed method is numerically and experimentally evaluated.

In the paper entitled 'A robust high-speed position control scheme based on computed torque method for 2 DOF flexible link robot arms' by K. Itamiya and M. Sawada, the problem of high-speed position control is considered for flexible link robot arms with modelling errors. For such flexible link robot arms with modelling errors, an adaptive identification method is proposed in order to decrease the modelling error from the control system in which a nominal control law is used. Moreover, the closed loop adaptive identification is employed to consider the movable range of the robot arm. Thus, the high-speed position control can be achieved by using parameter estimates. In addition, the effectiveness of the proposed method has also been demonstrated in the experimental results of the frequency response of the link angle and that of the deflection angle.

In the paper entitled 'Robustness investigation of the linear multi-variable control technique for power management of DFIG wind turbines' by Seyyed Ali Emami and Afshin Banazadeh, the control problem is considered for power management of doubly fed induction generator (DFIG) wind turbines. Here, a multivariable control technique is presented to optimally manage the power of the horizontal axis wind turbine. By applying all three controllers, it is shown that the control purpose is well satisfied for different situations. However, it is also shown that maximum power point tracking (MPPT) is not possible, only when the wind velocity cannot produce enough power. In addition, the robustness of the presented control method is discussed. For this, it is shown that the designed controller has a robust behaviour against the changes in uncertain parameters such as wind velocity and grid voltage amplitude.

In the paper entitled 'Multiple model adaptive control of a hydro turbine plant – performance of H_∞, LQG and PI controllers' by Chalang Hama Rasheed Mohammed and Sallehuddin Mohamed Haris and Zulkifli Mohd Nopiah, the weighted multiple model adaptive control (WMMAC) scheme has been applied to a hydro turbine plant. The linearised candidate estimator models were modified in accordance with the stability criteria of the virtual equivalence system (VES) and the adaptive mixing control (AMC) methods. H∞, LQG/LTR, and PI control schemes were employed in the design and optimisation of the multiple controllers. Moreover, some simulations were carried out, and the performances of three schemes were discussed. It can be observed from the simulation results that the PI control structure produced better performance compared to both the H∞ and the LQG/LTR controllers.

Finally, in the paper entitled 'Hybrid optimal filtering for linear continuous-time Markovian jump systems with non-Gaussian noises by MPT approach' by Gou Nakura, the problem of optimal filtering is considered for a class of linear continuous-time Markovian jump systems with non-Gaussian noises. By the most probable trajectory (MPT) approach based on principle of hybrid optimality, some necessary and sufficient conditions are derived for the solvability of the optimal filtering problems. In addition, several numerical examples are given to illustrate the effectiveness of the optimal filtering algorithms presented in the paper.

As guest editors of this special issue, we would like to thank the authors for their contributions. We believe that the readers will benefit greatly from the special issue. We would also like to thank the *International Journal of Advanced Mechatronic Systems* for giving us the opportunity to serve as guest editors. Finally, we would also like to thank the reviewers for their excellent job on evaluating these papers despite of the tight time schedule.