Editorial

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Biographical notes: Mingcong Deng is currently a Professor at Tokyo University of Agriculture and Technology, Japan. He is a member of SICE, ISCIE, IEICE, JSME, IEEJ and the IEEE(SM). He specialises in three complementary areas: operator-based non-linear fault detection and fault tolerant control system design; system design on thermoelectric conversion elements; and applications on smart material actuators. He has over 280 publications including 110 journal papers, nine books (or chapters), in peer reviewed journals including *IEEE Transactions*, IEEE Press and other top tier outlets. He serves as an Associate Editor of six international journals, including *IEEE Trans. on Automation Science and Engineering*. He is also co-chair of agricultural robotics and automation technical committee, IEEE Robotics and Automation Society.

Changan Jiang received his PhD from Okayama University, Japan in 2009. He is currently a Research Scientist with RIKEN-TRI Collaboration Centre for Human-Interactive Robot Research, Japan. His research interests include robotics, non-linear robust control with input non-linearity, vibration control, modelling of smart actuator and haptics device design and application.

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 Tokyo, Japan, September 18–21, 2012. In this special issue, seven technical contributions on advanced control method and application are selected for publication. They are researching on robust finite time functional observers, navigation of mobile robots, control of multi-legged robot, unbalance vibration control, priority decision for renewable energy potential, energy regeneration from vehicle vibration and vibration control of pneumatic anti-vibration apparatuses. The contents of these studies are briefly described below.

In contrast with the finite time observer in linear discrete systems, the finite time observer in linear continuous systems is an attractive feature if it is not restricted to the use of sampled-data or discrete-time techniques and there are few results in the literature thus far. The paper entitled 'Design of robust finite time functional observers in uncertain linear systems' by Wang, Xia and Yang, proposes a method to design a robust functional observer which can estimate the state linear functions of the uncertain linear systems almost in a predefined finite time. By using the offered design degrees of freedom, the robust indexes can be parameterised and the design problem of the robust finite time functional observers for the uncertain linear systems can be changed into a minimisation problem with some constraints. By solving the changed minimisation problem, a corresponding algorithm to design the robust finite time functional observers in the uncertain linear systems is proposed. Finally, a numerical example and its simulation results show the simplicity and effectiveness of the proposed design method.

The paper 'The navigation of mobile robots in non-stationary and non-structured environments' by Vladareanu, Tont, Vladareanu and Smarandache introduces the navigation of mobile walking robot systems for movement in non-stationary and non-structured environments. By processing inertial information of force, torque, tilting and wireless sensor networks (WSN) an intelligent high level algorithm is implementing using the virtual projection method. The dynamic robot walking is presented in correlation with a stochastic model of assessing system probability of unidirectional or bidirectional transition states, applying the non-homogeneous/ non-stationary Markov chains. The results show that the

proposed new navigation strategy of the mobile robot using Bayesian approach walking robot control systems for going around obstacles has increased the robot's mobility and stability in workspace.

Since many degrees of freedom of the 6-legged robot cause the state explosion problem, and it is impossible to apply the acquired policy to unknown complex environment such as rubbles, authors Nishigai, Nakatsuka and Ito of 'Control of multi-legged robot using reinforcement learning with body image and application to rubble' focus on the flexibility of the body of 6-legged robot and its body image. This paper addresses the autonomous control of a 6-legged robot using reinforcement learning, and apply it to rubbles. The body image solves the state explosion problem and the flexibility of the body compensates the difference between the simple simulated environment and the complex real environment. Authors developed a prototype of the robot and conducted experiments to confirm the effectiveness and the validity of the proposed framework. As the result, effective locomotion was realised.

To avoid deteriorations of dynamic and static characteristics caused by mass unbalance of magnetically levitated rotors, the paper 'A design method of a mode control and an unbalance vibration control for five-axes active magnetic bearing systems' by Okubo, Nakamura and Wakui, proposes an adjustment method based on experimental analysis. Experimental results of step response show effectiveness of the proposed method. On the other hand, the eccentricity of the rotor causes unbalance vibration, which is a common problem in rotating machinery. To suppress the vibration, automatic balancing system (ABS) and peak-of-gain control (PGC) are utilised. By using the ABS (the PGC), the bearing stiffness at rotational frequency is decreased (increased). In previous works, implementation methods for these have not been presented fully. Thus, in this paper, we considered the implementation of the ABS and the PGC. Moreover, practical advantages of the PGC/ABS are demonstrated by rotational tests of a turbo molecular pump.

The purpose of the paper 'Development of priority decision for renewable energy potential using analytical hierarchy process and geographical information system method', by Nagasaka and Rumbayan, is to develop decision making method for site selection and to rank the priority of renewable energy potential development site using Analytical Hierarchy Process (AHP) and Geographical Information System (GIS) in Indonesia. Based on the result, the site selection of 10 locations can be found to give the recommendation for priority development of renewable energy. In addition, the potential of renewable energy in term of technical potential, economic potential and carbon dioxide reduction potential are calculated based on assumption and reference by considering the application of renewable energy technology. The proposed methodology is useful to identify the renewable energy resources site for development priority.

The paper 'Effective energy regeneration from multi-mode-based vehicle vibration', by Hashimoto, Nagai, Kumagai and Kasai, presents a novel vibration power generation device for vehicles where effective power generation can be obtained by multi-mode vibration of the vehicles. The main advantage of the developed device is the power generation over wide frequency range. First, road tests of the vehicle are performed for several representative conditions such as mass and velocity variations, and then the obtained data is analysed. Next, a vibration power generation device specially designed for the vehicle is proposed. This new device is composed of the multiple masses and spring plates equipped with a lead zirconate titanate (PZT), and is effective in multi-mode vibration. Taking the road-test results into consideration, the design is carried out based on agreement between the resonant frequencies of the device and the vibration frequencies of the vehicle. The validity of the developed device is confirmed by the simulation and experimental results.

The paper 'Suppression of flow disturbance to pneumatic active anti-vibration apparatuses by smoothed and shaped signals', by Nakamura, Fukuda and Wakui, proposes the control method for vibration caused by variation of air pressure supplied to pneumatic anti-vibration apparatuses. In this method, air pressure variation, i.e., flow disturbance is estimated offline. The time-series data of disturbance estimate is added to the control input signal. Smoothing is utilised to reduce the noise of estimated signal. Moreover, to compensate effects of time-lag of input, two kinds of a shaped signal are also utilised. Experimental results show the effectiveness of the proposed vibration suppression method.

As guest editors of this special issue, we would like to thank all the authors for their contributions. We believe that the readers can benefit from the papers in this special issue. Finally, we would also like to appreciate the reviewers' excellent jobs on evaluating these papers.