Editorial

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This special issue focuses on researching into control techniques of mechatronic systems. Six technical contributions with high quality on this field are collected in this special issue. Those papers show the original research which is particularly on study of new control technologies for the synergistic combination of electronic control of systems, which cover a wide range of application areas.

The paper by T. Henmi et al. entitled 'Swing-up controller for the Acrobot using skill of human movements' presents a control method to swing up the Acrobot, which is a model of horizontal bar gymnast, is proposed. In order to materialise the movement of the Acrobot as same as movement of human, the swing-up controller of the Acrobot with considering limitation of joint which is model of human hip is proposed. From an analysis of the gymnastic technique called tap swing forward (TSF), the proposed swing-up controller can make the two links of the Acrobot do a human-like movement. Numerical simulation and experimental result to swing up of the Acrobot are given to show the effectiveness of the proposed method.

Mizumoto et al. deal with the design of an adaptive PID control system for non-linear systems with disturbances in 'Adaptive PID control system design for non-linear systems'. The proposed PID method utilises the output feedback exponential passivity (OFEP) characteristics of the controlled system. Further, a practical control system design with a parallel feed-forward compensator (PFC) is shown and the effectiveness of the proposed method is confirmed through experiments on a magnetic levitation system.

The paper 'Image-based visual servoing for power transmission line inspection robot' by S. Fu et al. describes a vision-based system for an inspection robot. The main emphasis of this paper is on an image-based visual servoing strategy for driving the robot arm with a pinhole camera toward a desired configuration in order to grasp the line. The method skips the step of transferring image features back to robot pose, and hence makes driving arm motion plans directly in the image plane, providing a 'visual' trajectory in the image plane for the gripper to track and locate the phase line and related obstacles in an effort to make the robot body align with the phase line. Experimental results using an inspection robot platform are presented, showing that good servoing can be achieved using the proposed controller of the vision system.

In 'Real-time optimisation for parallel-parking control of four-wheeled vehicles' J. Imae et al. present a real-time optimisation approach to the parallel-parking control problem, focusing on the lateral and yaw dynamics. First, the parallel parking problem as a control problem in a descriptor form is formulated. Then by introducing a new idea, the control problem is transformed into a kind of unconstrained optimal control problem, to which the real-time optimisation method is applicable. Finally, a numerical simulation is demonstrated to illustrate the effectiveness of our proposed approach.

A platform for digitalising 3D freedom surface is established by A. Li et al. in the paper entitled 'Hand-to-eye calibration for 3D surface digitalisation system'. In order to transform the range data returned by the sensor to those in the robot base coordinate system, a mathematical model is constructed based on the homogenous coordinate transform principle and DH definition. Furthermore, an algorithm for calibration of hand-mounted laser-stripe vision sensor is proposed. Accuracy performance of the calibration depends highly on the flatness of the reference plane and the approach can be automated by reorientation of the robot hand instead of changing the orientations of the reference plane. Highly accurate results have been achieved in both simulations and real experiments. Although the method is implemented in laser-stripe vision sensor, it is also adapt to other 2-D sensors.

The paper by M. Deng and A. Inoue entitled 'Adaptive vibration control of piezoelectric actuator based flexible arm with unknown and unmeasurable disturbances' presents adaptive control of a piezoelectric actuator based flexible arm with unknown and unmeasurable disturbances. In real systems with external disturbances and dynamics of actuator, the vibration effect due to the inherent elastic deformation of flexible arm means that satisfactory control results can not be obtained. To reduce the vibration effect and to consider the actuator dynamics based on an external disturbance model with consideration of dynamics of a piezoelectric actuator, adaptive vibration control experimental system is designed, where the controller is based on Youla-Kucera parametrisation and right coprime factorisation. Robust analysis of the proposed control system is also shown. As a practical appeal, simulation and

experimental results are shown to support the proposal on the control system design.

As guest editors, we would like to thank all the authors for their contributions to this special issue. We believe that the six papers presented in this special issue are representative of recent advances on control techniques of mechatronics and it is a fruitful area for interesting research and a lot of excellent contributions are being made.