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Editorial
Mathematical Approaches in Advanced Control Theories 2013

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Advanced control theory fills a gap between the mathematical control theory and modern control engineering practices. Conceptually, advanced control theories can include any theoretical problems related to the controller design. But in this issue it may include model predictive control, sliding mode control, robust control, real-time optimization, and identification and estimation, which are not limited to controller design. Advanced control technologies have become ubiquitous in various engineering applications (e.g., chemical process control, robot control, air traffic control, vehicle control, multiagent control, and networked control). The development of mathematical methods is essential for the applications of advanced control theories. Sometimes it lacks effective methods to tackle the computational issue (e.g., model predictive control of a fast process). Sometimes, a new application requires a brand-new solver for applying the advanced control theory (e.g., a new production line far exceeding the usual speed). The main focus of this special issue will be on the new research ideas and results for the mathematical problems in advanced control theories.

A total number of 83 papers were submitted for this special issue. Out of the submitted papers, 39 contributions have been included in this special issue. The 39 contributions consider several closely related and interesting topics.

The subjects in controller design/synthesis and system analysis have occupied 24 contributions. These contributions include, for example, adaptive control (see the work of C. Hu and Y. Liu for the air-breathing hypersonic vehicles and the work of W. Gai et al. for the neural network dynamic inversion with prescribed performance in aircraft flight control), H_∞ control (see the work of A. Moutsopoulou et al. for the active vibration control in intelligent structures and the work of Z. H. Ismail and M. W. Dunnigan for the robust technique for an autonomous underwater vehicle with region tracking function), model predictive control (see the work of H. Shen et al. for the vanadium redox flow battery modeled by neural network and the work of H. Shi et al. for the two-layered control of a continuous biodiesel transesterification reactor), sliding model control (see the work of H. Pang and X. Yang for robustifying the linear quadratic tracking controller and the work of S. I. Serna-Garcés et al. for an active postfilter based on two buck converters), networked control (see the work of L. Qiu et al. for the stability under random time delays and packet dropouts based on unified Markov jump model), backstepping technique (see the work of J. Liu et al. for output-feedback stabilization of stochastic nonlinear systems), fuzzy logic control (see the work of X.-X. Zhang et al. which presents a reference function based 3D design methodology using support vector regression learning), and neural network control (see the work of X. Li et al. which is designed under small world neural network model and is investigated in both linear and nonlinear controls).

Closely related to the controller design and synthesis are the 9 contributions on the estimation problem. These