Intelligent Computing in Measurement, Modeling and Control Applications (LSMS and ICSEE 2010)

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This special issue consists of 10 papers selected from over 800 submissions to the 2010 International Conference on Life System Modeling and Simulation, and the 2010 International Conference on Intelligent Computing for Sustainable Energy and Environment (LSMS-ICSEE’10) held on 17–20 September 2010, in Wuxi, China. It covers some recent new approaches in measurement, modelling and control applications where intelligent computing plays a key role.

The concentration of organic acids in anaerobic digesters is one of the most critical parameters for monitoring and advanced control of anaerobic digestion processes, and it is vital to have a reliable online measurement system in place. Wolf et al. investigated the prediction of organic acid concentration using UV/vis spectrometry measurements, and advanced pattern recognition methods were then used to map the non-linear relationship between measured absorption spectra to laboratory measurements of organic acid concentrations. Different machine learning techniques were tested and compared, and they found that both generalized discriminant analysis and support vector machine (SVM)-based classifiers can produce accurate prediction with classification rates in excess of 87% achieved on test data.

Wang et al. studied non-invasive measurement of haemoglobin, and they used a dynamic spectrum (DS) method to minimize the discrepancies between the individuals and the complicated measurement conditions when near-infrared spectroscopy was applied. Data were obtained from in vivo measurements on 110 subjects, and a neural network was then used to establish the calibration model of haemoglobin concentration against DS data. Their experimental tests concluded that the DS method has the potential to be used for non-invasive monitoring of haemoglobin concentration changes.

The radial basis function (RBF) networks have been widely used in non-linear system modelling; however, the non-linear parameters in the network such as the widths are not easy to determine. Deng et al. proposed a new two-stage construction algorithm where the particle swarm optimization method was used to search for the optimal RBF centres and their associated widths. They found that although the new method needs more computation than conventional approaches, it can greatly improve the model sparseness and the model generalization performance.

Li and Yang investigated the parameter estimation problem for the output error moving average systems. With the aim to reduce the computational complexity of the existing identification methods, they proposed a new interactive stochastic gradient algorithm to improve the convergence rate and estimation accuracy.

The microgrid has drawn a lot of interests in recent years. Li et al. proposed a co-ordinated dispatch model for both electricity and heat for a 1-day-ahead situation. In addition to operational constraints, network loss and physical limits were incorporated into the model. The load performance of combined heat and power was modelled using a curve fitting method, and an electric heater was introduced into the model to improve the economy and flexibility of the microgrid operation. Then, the particle swarm optimization method was used for the operation scheduling to minimize the total operational cost.

Li et al. investigated the probabilistic load flow (PLF) calculation for grid-connected induction wind power systems. They first introduced probabilistic models for main components in a wind power generation system, and a combined iterative method for deterministic load flow is then extended to the PLF calculation. To overcome the drawback of simple random sampling, they proposed to combine the Latin hyper-cube sampling (LHS) technique with Monte Carlo simulation. The proposed method was verified on an IEEE 14-bus system added with 20 wind turbines, and simulation results confirm the efficacy of the proposed method.

The networked control system (NCS) has been a hot topic in recent years due to the rapid development of information and communication technology. Du et al. investigated the modelling and stability of multi-input–multi-output (MIMO) networked control systems with multi-channel random packet losses. To solve the network-induced non-deterministic factors, a general switched system model with unknown switched

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sequence for multi-channel MIMO NCSs was proposed. Based on Lyapunov stability theory combined with the linear matrix inequalities (LMIs) techniques, a sufficient condition was then derived that could also be extended to uncertain MIMO NCSs. Yang et al. on the other hand researched the mean square exponential stabilization of networked control systems with Markovian packet dropouts. Using the average dwell time method, they designed a state feedback controller to guarantee the mean square exponential stability. Finally, Deng et al. developed a LMI approach to stabilize networked control systems with signal-to-noise ratio (SNRs) constrained channels. The minimal SNRs required for stabilizability were obtained by a novel LMI approach.

Finally, Jia et al. investigated neuro-fuzzy-based dynamic quadratic criterion-iterative learning control for batch processes. They first used the neuro-fuzzy-based quadratic criterion-iterative learning control with dynamic parameters to improve the performance of conventional iterative learning control (ILC). Then, they provided a rigorous description and proof to confirm that the change of the ILC policy converges with respect to the batch index number.

In summary, these 10 papers only serve as an introduction to some recent developments in measurement, modelling and identification, and control applications in which intelligent computing plays a key role to improve the performance. It is hoped that this issue will serve as a catalyst for future such research. Finally, we would like to thank the reviewers who have helped with the review process for this special issue, and the authors for their effort in expanding and revising their papers to meet the reviewer comments.