Intelligent computing and applications (LSMS and ICSEE 2010)

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This special issue consists of nine papers selected among over eight hundred submissions to the 2010 International Conference on Life System Modeling and Simulation, and 2010 International Conference on Intelligent Computing for Sustainable Energy and Environment (LSMS-IC-SEE'10) held on 17–20 September, 2010, in Wuxi, China.

Many real-world problems can be formulated as optimization problems, but they are complex and NP hard, and conventional optimization approaches often fail to perform well. Intelligent optimization algorithms have thus become the attractive alternatives. The first five papers cover some new methods and their applications.

Zhang et al. investigate two-stage multi-item inventory systems with stochastic demands. Due to the complexity of stochastic inventory optimization in a multi-echelon system, few analytical models and effective algorithms exist. In the paper, they establish exact stochastic optimization models and propose an efficient hybrid genetic algorithm (HGA). Monte Carlo method is then used to simulate the actual demand and thus to approximate the long-run average cost. The numerical experiments show that when the variance of stochastic demand increases, echelon policy

outperforms installation policy and the proposed heuristic search technique can significantly enhance the search capacity.

Wang, Zhao, and Li research the Support Vector Domain Description (SVDD) for the detection of novel data or outliers where the training of a SVDD is a constrained quadratic programming problem. They develop a linear Particle Swarm Optimization for such problems. To overcome the premature convergence, a converging linear PSO is proposed to guarantee at least a local optimum. Experimental results show the efficacy of the proposed method.

In order to maximize the amount of final products while reducing the production of by-products in batch processes, Jia, Cheng, and Chiu propose an improved multi-objective particle swarm optimization method based on Pareto-optimal solutions. A novel diversity preservation strategy is used to select the global best and thus enable the convergence and diversity of the Pareto front. Simulation results on benchmark examples and two classical batch processes verify the efficiency and practicability of the proposed algorithm.

Xu et al. study the optimal bandwidth scheduling problem for networked two-layer learning control systems where multi-networked feedback control loops share a common communication media. They first formulate a noncooperative game fairness model, taking into account factors such as transmission rate, sampling rate, scheduling patterns, and networked control. Then, an improved shuffled frog leaping algorithm is used to obtain the optimal solutions. They show that the algorithm has a high convergence rate, and simulation results show the effectiveness of the proposed method.

Finally, Xu et al. propose a new multi-population cultural differential evolution algorithm. In the algorithm, each of the populations is managed by its private cultural

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differential evolution algorithm, a center individual is introduced into the belief space, and a new selection function is used to select the offspring for the next generation. To accelerate the convergence speed, the populations exchange their knowledge with each other for every generation. An adaptive mechanism of population diversity preservation is proposed to prevent the populations from being trapped in local optima. The algorithm is further applied to a practical optimization problem in an ammonia synthesis system with the objective to maximize the net value of ammonia. The results indicate the effectiveness of the proposed approach.

This issue includes one paper on the application of neural networks. Liu et al. investigate the application of an improved nonlinear principal component analysis (PCA) to detect faults in polymer extrusion processes. Since the processes are complex in nature and nonlinear relationships exist between the recorded variables, an improved nonlinear PCA, which incorporates the radial basis function (RBF) networks and principal curves, is proposed. This algorithm comprises two stages. The first stage involves the use of the serial principal curve to obtain the nonlinear scores and approximated data. The second stage is to construct two RBF networks using a fast recursive algorithm to solve the topology problem in traditional nonlinear PCA. The benefits of this improvement are demonstrated in the practical application to a polymer extrusion process.

Finally, three papers on signal and image processing are selected into this special issue.

Zhang et al. study the watermarking technology that can be viewed as a process of image fusion. They assume that the watermarked image is a steady state, and the Kalman filter can then be used as an optimal estimation algorithm for image fusion. They build models representing the watermarked image and the original image and find that the optimal estimation is achieved when the minimum

estimation error variance is reached. Experimental results demonstrate that the proposed algorithm can achieve good performance.

Zhang and He investigate the electroencephalography (EEG) signals that are known to be nonstationary and time varying. Time–frequency representation is a useful tool for such signals, and they introduce quantitative methods that can translate complicated and subjective waveform-based EEG analysis into objective measures to characterize EEG signals recorded from both normal subjects and cerebral infarction (CI) patients. Relative frequency band energy is computed from time–frequency plane for five different subbands, and the Shannon entropy is used to detect the difference in EEG for the two kinds of subjects. Finally, the temporal evolutions of these quantitative parameters are presented to trace EEG changes.

Finally, Zhang et al. study pyramid matching kernel methods for image processing. They note that such methods often suffer from distortion factors that increase linearly with the feature dimension. Therefore, they propose a new method by consistently dividing the feature space into two subspaces while generating several levels. In each subspace of the level, the original pyramid matching is used. Then, a weighted sum of every subspace at each level is used as the final measurement of similarity. Experiments on data set Caltech-101 and ETH-80 show that the computational complexity of their dimension partition pyramid matching kernel methods is significantly reduced.

In summary, these nine papers only serve as an introduction on the recent developments in intelligent computing techniques and their applications. It is hoped that this issue will serve as a catalyst for future such researches. Finally, we would like to express our deepest gratitude to many reviewers who have helped with the review process for this special issue, and the authors for their endeavored effort in contributing the papers.