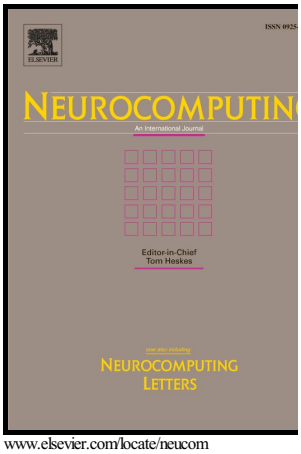

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Editorial: Special issue: Life System Modelling and Simulation

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Editorial:

Special issue: Life System Modelling and Simulation

As well recognised, a life system consists of micro and macro components, for example, cells, tissues and organisms. These components need to communicate with each other in order for a system to demonstrate complex behaviours. However, due to the complexity of a life system, it is hard to understand the interaction between components and predict system behaviours. People have started using computational methods and artificial intelligence approaches in system science, biology, as well as bio-inspired paradigms to model life systems. Although significant progress has been made in the research of life systems, the capability of developed methods still cannot match the demands of exploiting life systems. Computational intelligence approaches are still in their embryo stages when they are used for handling life systems.

The primary purpose of this special issue is to organise a collection of recently developed computational intelligence techniques in the fields of life system modelling and simulation as well as life system-inspired theory and methodology. The special issue is intended to be an international forum for researchers to report the recent developments in these fields in an original research paper style.

This special issue includes ten papers in ten different topics such as camera calibration, network control and compound identification. The papers are extended versions of published papers from the 2014 International Conference on Life System Modeling and Simulation (LSMS2014) (http://lsms-icsee-2014.shu.edu.cn/). Details of the papers are as follows.

(1) Camera calibration

Camera calibration is one of the fundamental issues in computer vision, aims at determining the intrinsic and exterior camera parameters using 2D image features and the corresponding 3D features. *Deng et al.* proposed a relationship model for camera calibration in which the geometric parameter and the lens distortion effect of camera are taken into account in order to unify the world coordinate system (WCS), the camera coordinate system (CCS) and the image coordinate system (ICS). Differential evolution was combined with a particle swarm optimization algorithm in order to calibrate the camera parameters effectively.

(2) Quadratic separation

Zheng et al. investigated the stability analysis of a class of systems with time delays using a Quadratic Separation (QS) framework. A novel method for the construction of Integral Quadratic Constraints (IQCs) that could be used in the QS framework was proposed. A unified framework was proposed based on the QS theory and the Lyapunov theory, and then was applied to the stability analysis of linear systems with time delays. Stability criteria were also established based on the proposed approach.

(3) Network control

Zhang et al. proposed a novel adaptive event-triggered communication scheme for networked

control systems (NCSs) with randomly occurring nonlinearities and uncertainties. Firstly, an adaptive event-triggered communication scheme for NCSs was proposed, which can adaptively adjust the trigger parameter with respect to the dynamic error to save the limited network resources while ensuring the desired control performance. Secondly, an integrated model of the studied system was built under consideration of the network-induced delay, adaptive event-triggered communication scheme and randomly occurring nonlinearities and uncertainties in a unified framework. Then, a sufficient stability criterion to judge the mean-square sense asymptotical stability and a stabilization criterion to co-design the parameters of the communication scheme and controller were proposed for the system under consideration.

(4) Biological network

The reconstruction of biological networks from experimental time series data is one of the challenges in systems biology. Currently, most network reconstruction approaches usually yield one solution. In contrast, one of the recent advances is to generate all possible minimal solutions fitting the given set of data, and thus reveals all alternative mechanisms to explain the biological phenomena under study. Although this is interesting and helpful, the generated solutions are usually too many and thus difficult to manage. *Liu et al.* proposed the use of colored Petri nets to represent all possible solutions for a network reconstruction problem by encoding each solution as a color. Specifically, they presented two folding (coloring) approaches for generating colored Petri net models for a given set of Petri net networks (solutions). To do this, they not only offered a compact representation of all solutions in one colored model for a given network reconstruction problem, but also facilitated the analysis of each solution by choosing its corresponding color. They showed an application of their coloring approaches by taking the phosphate regulatory network in enteric bacteria as an example.

(5) Compound identification

Identifying promising compounds from a vast collection of potential compounds is an important and yet challenging problem in chemical engineering. An efficient solution to this problem will help to reduce the expenditure at the early state of chemical process. In an attempt to solve this problem, the industry is looking for predictive tools that would be useful in testing optimal properties of a candidate compound earlier. *Ma et al.* investigated the application of biogeography-based optimization (BBO) to achieve such predictive work. BBO is a new evolutionary algorithm that is based on the science of biogeography. BBO is a population-based search method that achieves information sharing by species migration.

(6) Energy saving

Modern control methods like optimal control and model predictive control (MPC) provide a framework for simultaneous regulation of the tracking performance and limiting the control energy, thus have been widely deployed in industrial applications. Yet, due to its simplicity and robustness, the conventional P (Proportional) and PI (Proportional-Integral) control are still the most common methods used in many engineering systems, such as electric power systems, automotive, and Heating, Ventilation and Air Conditioning (HVAC) for buildings, where energy efficiency and energy saving are the critical issues to be addressed. Little has been done so far to explore the effect of its parameter tuning on both the system performance and control energy consumption, and how these two objectives are correlated within the P and PI control framework. *Wu et al.* proposed a new method where the P and PI controllers were designed with a

simultaneous consideration of these two aspects. Two case studies were investigated in detail, including the control of Voltage Source Converters (VSCs) for transmitting offshore wind power to onshore AC grid through High Voltage DC links, and the control of HVAC systems.

(7) Distribution network

Active distribution network (ADN) is a feasible development direction of future smart distribution networks. On the basis of integration modes, *Wei et al.* presented an economic optimal model of distributed generation (DG) integration from the perspective of distributed system operators (DSO) where three DG integration indexes were defined: integration ratio, gas chromatography (GC) ratio and adjustable power factor. The hourly sequential model has been adopted to simulate loads and DG uncertainties. The application of optimal power flows in obtaining operation states of application delivery network (AND) and the fundamental of stochastic power flows based on Monte Carlo Simulation were introduced. A new method of DG optimal integration based on stochastic optimal power flow (S-OPF) was also presented.

(8) Compound identification

Attribute Reduction (AR) is an important preprocessing step for data mining.AR based on rough set is an efficient method. Its reduction performance has been verified to be better or comparable with other methods in large amount of works, but existing reduction algorithms have some problems such as slow convergent speed and probably converging to a local optimum. *Luan et al.* reported a novel attribute reduction algorithm based on Artificial Fish Swarm Algorithm (AFSA) and rough set. Since AFSA has a slow convergence rate in the later phase of iterations, normal distribution function, Cauchy distribution function, multi-parent crossover operator, mutation operator and modified minimal generation gap model were adopted to improve AFSA. The attribute reduction algorithm based on improved AFSA and rough set takes full advantages of the improved AFSA and rough set, which are faster, more efficient, simpler, and easier to be implemented.

(9) MIMO Hammerstein Model

A novel identification method for neuro-fuzzy based MIMO Hammerstein model by using the correlation analysis method was presented by *Jia et al.* A special test signal that contained independent separable signals and uniformly random multi-step signal was adopted to identify the MIMO Hammerstein process, resulting in the identification problem of the linear model separated from that of nonlinear part. As a result, the identification of the dynamic linear element can be separated from the static nonlinear element without any redundant adjustable parameters. Moreover, it can circumvent the problem of initialization and convergence of the model parameters discussed in the existing iterative algorithms used for identification of MIMO Hammerstein model.

(10) Swarm intelligence

Natural phenomenon of mixed flocks indicates such principles as cooperation and social symbiosis among various species. Inspired by the organization and collective intelligence of natural mixed flocks, a mixed swarm based particle swarm optimization (MCPSO) was proposed by *Jie et al.* to efficiently handle the trade-off between the global and local search in PSO. The approach divided all particles into two species, i.e., exploration species and exploitation species.

Exploration species undertook the coarse search in the solution space to discover new potential area, while the exploitation species was instructed accordingly to conduct fine search in its activity territory. Information sharing plays a crucial role between the two species, through the cooperative mechanism, not only does MCPSO avoid the optimum missed in a coarse search, but also it significantly saves void fine search.

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