Editorial

Tsan Sheng Ng*

Department of Industrial and Systems Engineering,
National University of Singapore,
1 Engineering Drive 2, 117576, Singapore
Email: isentsa@nus.edu.sg
*Corresponding author

Chee Khiang Pang

Department of Electrical and Computer Engineering,
National University of Singapore,
4 Engineering Drive 2, 117583, Singapore
Email: justinpang@nus.edu.sg

Biographical notes: Tsan Sheng (Adam) Ng is currently an Associate Professor with the NUS, Faculty of Engineering, Department of Industrial and Systems Engineering (ISE). His research interests include operations research in energy and sustainability, and robust optimisation modelling. He has published in various international peer-reviewed journals, and has also worked on a variety of industrial and state funded research projects including oil and gas planning and energy and sustainability. He is currently a member on the Institution of Engineers Singapore (IES) Systems Engineering Technical Committee, and also an editorial board member of the journal of *International Journal of Automation and Logistics*.

Chee Khiang (Justin) Pang is currently an Assistant Professor in the Department of Electrical and Computer Engineering, National University of Singapore, Singapore. He is also an A*STAR Singapore Institute of Manufacturing Technology Associate, Faculty Associate of A*STAR Data Storage Institute, a senior member of IEEE, and a member of ASME.

The 18th Asia Pacific Symposium on Intelligent and Evolutionary Systems (IES 2014), hosted at the Nanyang Executive Centre, was held in Singapore, from November 10–12, 2014. The IES 2014 was sponsored by the Memetic Computing Society and co-sponsored by the SIMTECH-NTU Joint Lab, and the Computational Intelligence Research Laboratory at the School of Computer Engineering, Nanyang Technological University, and supported by the National University of Singapore and Nanyang Technological University. The conference General Chairs were Professors Kay Chen Tan and Yew Soon Ong, and the Program Chairs were Professors Hisao Ishibuchi and Hisashi Handa. In total, 153 submissions were received worldwide, and 106 papers were accepted for presentation at the invited and regular sessions, which represents an acceptance rate of 69%. Among these papers, we have selected nine research articles for this special issue from high-quality results presented at the conference which represent the latest developments in intelligent and expert methods for sustainable industrial systems. The papers were consolidated to provide the potential readers a broader

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perspective of this currently emerging research topic, as well as a comprehensive background of the state-of-the-art approaches for sustainability.

The challenges faced by modern industry systems in the era of continued intense competition and increasing concerns of environmental sustainability include maximising productivity, ensuring high product quality, as well as reducing production wastes, costs, and undesirable environmental impacts simultaneously. Many important industrial design and planning problems are often plagued with conflicting objectives and uncertainties. As such, it is of paramount importance to develop effective decision support and capabilities to assist managers and stakeholders in various critical phases of data collection, problem analysis, clarification, and solution process. An intelligent systems approach can be defined as one that synthesises the tools and methods of control theory, operations research, and artificial intelligence to support the modelling, analysis, and design of complex systems. Expert systems methodologies further enrich the approach by synthesising the state-of-the-art computational techniques with the requisite knowledge bases distilled from human expertise. Such a holistic and synergistic approach provides the necessary arsenal and capability to cope with the increasing complexities of the systems that we work and live in, including manufacturing, service, and socio-economic systems, etc. The theoretical development and advancement of intelligent and expert systems methodologies and technologies, and the realisation of their value-add through real-world applications, continues to be an important and thriving research area.

In this special issue, we aim to bring together a showcase of top research developments in the area of intelligent and expert systems for sustainable industrial applications. Firstly, Sato and Hashimoto proposed a multi-objective evolutionary algorithm for a two-stage multi-criteria decision-making system. With the incorporation of user preferences, high quality multi-level robust solutions at three different noise levels with 3,000 generations were shown to be at least as good as other algorithms with 8,000 generations using benchmark noisy optimisation problems. The development of analytics in design optimisation problems for sustainable industrial systems continue to see rapid advances and rich growth in research value. In this aspect, Chiba et al. proposed a multidisciplinary design optimisation methodology using a hybrid evolutionary computation for a hybrid rocket engine launch vehicle. By combining data mining methods using a self-organising map and stratum-type association analysis, the design space structurisation order was implemented to observe the effectiveness of the local regions of each design variable, achieving 90% confidence results for rocket launch vehicle design problem with hierarchical dendograms. Next, Kanazaki et al. developed a Kriging-based genetic algorithm to optimise the parameters of the operating conditions of plasma actuators. When applied on a lift maximisation problem of a circular cylinder, the duty ratio parameters of the plasma actuators and their two-way interaction were identified as key variables which contributed more than 60% of significant effects in the lift maximisation via variance analysis. The optimum designs and global design information were also obtained within a very modest number of experiments as compared to a full factorial experiment. In the area of sustainable building design, system engineers continue to face conflicting challenges of power consumption and occupant comfort requirements, and Kan et al. proposed a novel multi-agent control system with intelligent optimisation for heating, ventilation, and air-conditioning (HVAC) applications. It was demonstrated that the optimal agent task scheduling solutions generated achieved high occupant comfort levels while increasing energy utilisation efficiency, consequently,

reducing energy costs and power consumption of computer simulation examples from 152 units to 78 units.

A prominent characteristic in complex and sustainable systems is the interconnectivity of intelligent decision agents in network structures. Advances in network analysis provide important decision support in critical events such as disaster incidents. To address this concern, Fukuda and Tanimoto developed a network model motivated by epidemiological and vaccination dynamics to study the impact of the presence of 'stubborn' individuals on population behaviour. A simulated epidemic vaccination problem which randomly distributed a 10% of 'stubborn' vaccinated individuals into the network showed significant improvement of the promotion population vaccination and inhibition of epidemic spread. The insights of such work are instrumental in creating new leverage points in similar large-scale complex systems, including social networks. On the other hand, Iwanaga and Namatame investigated the collective behaviour of agents such as market dynamics and traffic congestion, using a cascaded network model with deterministic turn-based decision agents. Computational studies on simulated agent networks with 1,000 agents revealed that final collective behaviour of the agents exhibited a stochastic-like behaviour, even when the decision rules and parameters were deterministic. The order in which choices were made also had significant influence on the final collective behaviour and contagion speed, revealing important insights on the prediction and control of emerging behaviour of social network systems. Network analysis is also extremely relevant to large-scale supply chain models. To study the impact and mitigation of supply chain disruptions, Yin et al. proposed a network connectivity embedded k-means clustering approach to determine at-risk clusters of nodes that share similar risk profiles and linkages with the focal company. The proposed clustering approach can be used to reduce the complexity of a large supply chain networks, hence, facilitating fast and in-depth analysis of the network behaviour. The effectiveness of the proposed approach was illustrated by simulation experiments on 160 node large scale supply chain model which successfully identified the 32 risk clusters and critical risk zones. Takadama et al. developed an evolutionary multi-objective optimisation approach for airline fleet scheduling and routing, and the methodology was applied it to a Japanese domestic airport network system to resolve conflict and congestion issues. The generated flight networks can potentially result in 992 and 700 million yen earnings in on-peak and off-peak months close to the same profit in actual data, even when the assumption on non-regular flight rate was 18.5% as compared to the actual rate of 30%. Morimoto et al. also proposed a multi-agent optimisation approach to a bus route network optimisation to resolve bottlenecks situations that arise in the event of severe disruption events. Through simulation experiments based on a 14 station network problem in existing literature, the network solutions generated can effectively transport over a 1,000 stranded commuters from stations to alleviate the congestion using only the original 77 buses available as compared to conventional methods which required significantly higher resources of 92 buses.

The guest editors hope this special issue provides potential readers and fellow researchers with a comprehensive coverage of intelligent and expert techniques to improve the stability, robustness, and overall performance for sustainable industrial systems. The guest editors wish to express his sincere gratitude to the Editor-in-Chief, Professor Jason Gu, for his invaluable, guidance, support and patience. The guest editors would also like to thank the reviewers for their time and contribution in expertise.