Proposal for Special Session

- **Title :**

Computational Intelligence Methods for Hybrid Renewable Energy Systems Management

- **Symposium:**

2017 IEEE Symposium on Computational Intelligence Applications in Smart Grid (IEEE CIASG'17)

- **Organizers**

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Scope and call for papers

Due to the rapid industrialization and the scarcity of conventional energy resources such as coal and natural gas, it has become increasingly urgent to search for alternative energy resources to meet the present energy demand. Renewable energy sources like solar and wind are sustainable and environmental friendly, and so have become promising alternatives. However, they are often criticized by their unpredictable nature. Hybrid renewable energy systems (HRES) that integrate different renewable energy sources together have the potential to reduce the impact of uncertainties of these energy resources, and thus improving the energy supply reliability.

However, there are many complicated issues involved in a HRES where computational intelligence methods might be beneficial. For example, the HRES architecture design/management usually needs to consider multiple objectives (such as the lifetime system cost, carbon emissions, and the system reliability), which effectively is a multi-objective optimisation problem. Evolutionary multiobjective algorithms are good options for these problems. The solar/wind energy supply is highly depended on the weather. To ensure a constant energy supply, effective methods for weather prediction are required. Computational intelligence methods such as neural networks are helpful. A HRES often has many different loads. Suitable classifications of these loads as well as an accurate identification of different loads characteristics are important for the management of HRES loads. Effective data mining and processing methods based on computational intelligence methods are useful.

Given to all these facts, the need to bring computational intelligence methods to tackle issues arise in Hybrid Renewable Energy Systems Management has become apparent. Thus, this special session aims to showcase and collate the most exciting and recent advances in computational intelligence for HRES management, and to cross-fertilizate between academic research and industry applications, and to stimulate further engagement with the user community of computational intelligence methods.

We invite submissions of previously unpublished, original and recent research on HRES management. The special session also welcomes survey, position, and research papers

- **Topics of interest (but are not limited to)**

1 Multi-objective/Many-objective optimal HRES architecture design
2 HRES management under dynamic/uncertain environments
3 HRES management under high dimensional decision space
4 Robust optimization approaches for HRES management
5 Other related optimization issues in a HRES
6 HRES load forecasting using computational intelligence methods
7 Intelligent classification of HRES loads
8 Intelligent HRES load characteristics identification
9 Other related data processing and data mining methods for HRES
10 Applications
11 Survey current studies on HRES management
12 Survey state-of-the-art computational intelligence methodologies
13 Other closely related topics on computational intelligence for HRES

- **Author's Schedule**

For the deadline for submitting papers, please check the website of SSCI 2017: http://www.ele.uri.edu/ieee-ssci2017/CIASG.htm

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- **Short CV for Each Organizer:**

Rui Wang is a lecturer at the Department of Systems Engineering, National University of Defense Technology (NUDT), China. He received his BEng degree from NUDT in 2008 and his PhD degree in Control and Systems Engineering from The University of Sheffield (2010.10-2014.01). He was a visiting researcher at CINVESTAV-IPN, Mexico, IIT-Kanpur, India, and the City University of Hong Kong.

His research interests are multi-criteria decision-making, evolutionary multi-objective optimization, data mining and their applications in science and industry. He was a Local Organizing Committee member for EMO 2013 and He was co-organizer of the 2014 WCCI-EMO, 2014 IEEE-SSCI-MCDM and 2015 IEEE-CEC-DMOO special sessions. \

Selected Publications:

[1]. **Wang, R.**, Zhang, T., Multi-objective optimal design of hybrid renewable energy systems using MOEA/D, international Conference on Renewable Energy Research and Applications, IEEE, USA. 2014, pp. 161-167
[2]. Shi Z.C., **Wang R.**, Zhang T. Multi-objective optimal design of hybrid renewable energy system using an enhanced PICEA-g, Solar Energy. DOI: 10.1016/j.solener.2015.03.052
[3]. **Wang, R.**, Purshouse, R. C., Fleming, P. J., Preference-inspired co-evolutionary algorithms using weights for many objective optimisation , European Journal of Operations Research, 243(2), 423-441, 2015.
[4]. **Wang, R.**, Purshouse, R. C., Giagkiozis, I., Fleming, P. J., The iPICEA-g a new hybrid evolutionary multi-criteria decision making approach using the brushing technique, European Journal of Operations Research, 243(2), 442-453, 2015
[5]. **Wang, R.**, Purshouse, R. C., Fleming, P. J., Preference-inspired co-evolutionary algorithms for many objective optimisation, IEEE Transactions on Evolutionary Computation., 17 (4), 474-494, 2013.
[6]. **Wang, R.**, Fleming, P. J., Purshouse, R. C., General framework for localised multi-objective evolutionary algorithms, Information sciences, 258(2), 29-53, 2014.
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[8]. **Wang, R.**, Purshouse, R. C., Fleming, P. J., Local preference-inspired co-evolutionary algorithms, in: GECCO 2012: Proceedings of the Genetic and Evolutionary Computation Conference, ACM,

Philadelphia, USA, 2012, pp. 513-520.

[9]. **Wang, R.**, Purshouse, R. C., Fleming, P. J., Preference-inspired co-evolutionary algorithm using adaptively generated goal vectors, Evolutionary Computation (CEC), 2013 IEEE Congress on. IEEE, Cancun, Mexico, 2013: 916- 923.

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[11]. **Wang, R.**, Purshouse, R. C., Fleming, P. J., Preference-inspired co-evolutionary algorithms using weight vectors for many-objective optimisation, Proceeding of the fifteenth annual conference on Genetic and evolutionary computation conference, GECCO 2013, ACM, Amsterdam, The Netherlands, 2013, pp. 101-102.

[12]. **Wang, R.**, Purshouse, R. C., Fleming, P. J., whatever works best for you-a new method for a priori and progressive multi-objective optimisation, in: Evolutionary Multi-Criterion Optimization, Springer, 2013, pp. 337-351.

[13]. **Wang, R.**, Zhang, Q.F., Zhang, T., Pareto adaptive scalarising function for decomposition based algorithms in: Evolutionary Multi-Criterion Optimization, Springer, 2015, **Accepted**.

[14]. **Wang. R**., Zhang T, and Guo B, An enhanced MOEA/D using uniform directions and a pre-organization procedure, Evolutionary Computation (CEC), 2013 IEEE Congress on. IEEE, 2013: 2390-2397.Purshouse R. C. , Deb K., Mansor, M. M., Mostaghim S., **Wang R**., A Review of Hybrid Evolutionary Multiple Criteria Decision Making Methods , 2014 WCCI, Beijing, China, pp. 389-397.

[15]. Shi Z.C., **Wang R.**, Zhang T. PICEA-g using an enhanced fitness assignment method, 2014 IEEE symposium series on Computational Intelligence. Oreland, USA, 1340-1347.

Zhang Yan is a research associate at the National Key Laboratory of Science and Technology on Vessel Integrated Power System, Naval University of Engineering, China. He received his B.S. degree from the Sichuan University (SCU), P.R. China, in 2010, and the Ph.D. degree from the National University of Defense Technology (NUDT), P.R. China in 2016.

His research interests include model predictive control application for smart grid and microgrids, energy management and optimization, optimization methods on microgrid and energy internet.

Selected Publications:

[1]. **Yan Zhang**, Baolong Liu, Tao Zhang, Bo Guo, An Intelligent Control Strategy of Battery Energy Storage System for Microgrid Energy Management under Forecast Uncertainties. International Journal of ELECTROCHEMICAL SCIENCE, 2014, 9: 4190-4204.

[2]. **Yan Zhang**, Jie Meng, Bo Guo, Tao Zhang. An Improved Dispatch Strategy of a Grid-Connected Hybrid Energy System with High Penetration Level of Renewable Energy. Mathematical Problems in Engineering, 2014.

[3]. **Yan Zhang**, Tao Zhang, Bo Guo. MPC based approach for reliable power system energy management with high penetration level of renewable energy resources. Energy Research and Power Engineering 2014, 986: 371-376.

[4]. **ZHANG Yan**, ZHANG Tao, LIU Yajie, et al. Optimal Energy Management of a Residential Local

Energy Network Based on Model Predictive Control[J]. Proceedings of the CSEE, 2015, 35(14): 3656-3666.

[5]. **Zhang Y**, Wang R, Zhang T, et al. Stochastic Model Predictive Control Based Economic Dispatch for Hybrid Energy System Including Wind and Energy Storage Devices. Computational Intelligence, 2015 IEEE Symposium Series on. IEEE, 2015: 1267-1271.

[6]. Chen Z, **Zhang Y**, Zhang T. An intelligent control approach to home energy management under forecast uncertainties. Power Engineering, Energy and Electrical Drives (POWERENG), 2015 IEEE 5th International Conference on. IEEE, 2015: 657-662.

[7]. **Zhang Y**, Zhang T, Wang R, et al. Optimal operation of a smart residential microgrid based on model predictive control by considering uncertainties and storage impacts. Solar Energy, 2015, 122: 1052-1065.

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[10]. **ZHANG Yan**, ZHANG Tao, LIU Yajie, et al. Stochastic Model Predictive Control for Energy Management Optimization of an Energy Local Network[J]. Proceedings of the CSEE, 2016, 36(13): 3451-3462

[11]. **Zhang Y**, Zhang T, Wang R, et al. An innovative real-time price based distributed optimal energy management of multi-microgrids in a smart distribution system. Innovative Smart Grid Technologies-Asia (ISGT-Asia), 2016 IEEE. IEEE, 2016: 341-346

[12]. **Zhang Yan**, Zhang Tao, Wang Rui, Liu Yajie, Guo Bo. Dynamic dispatch of isolated neighboring multi-microgrids based on model predictive control. 2016 International Conference on Smart Grid and Clean Energy Technologies. IEEE, 2016: 50-55

[13]. **Zhang Yan**, Zhang Tao, Wang Rui, Liu Yajie, Guo Bo. A model predictive control based distributed coordination of multi-microgrids in Energy Internet. IEEE/CAA Journal of Automatica Sinica. accepted

Tao Zhang is a professor at the Department of Systems Engineering, National University of Defense Technology (NUDT), China. He received his BEng, MEng and PhD degree from NUDT in 1998, 2001 and 2004, respectively.

His research interests include energy internet network management, hybrid renewable energy system design, multi-objective optimisation and decision making, scheduling, etc. Currently he is the head of the Department of Systems Engineering in NUDT, the chair of the energy internet network center. He is a senior member of the China Operation Research community, and since 2013 is serving as an associate editor for Defense Technology.

Selected Publications:

[1]. Yan Zhang, Baolong Liu, **Tao Zhang**, Bo Guo, An Intelligent Control Strategy of Battery Energy Storage System for Microgrid Energy Management under Forecast Uncertainties. International Journal of ELECTROCHEMICAL SCIENCE, 2014, 9: 4190-4204.

[2]. Yan Zhang, Jie Meng, Bo Guo, **Tao Zhang**. An Improved Dispatch Strategy of a Grid-Connected Hybrid Energy System with High Penetration Level of Renewable Energy. Mathematical Problems in Engineering, 2014.

[3]. Yan Zhang, Baolong Liu, **Tao Zhang**, Bo Guo, Multi-objective dispatch of a microgrid with battery energy storage system based on model predictive control. 4th International Conference Energy, Environment and Sustainable Development (EESD 2014), 2014.

[4]. Shengjun Huang, Yan Zhang, Bo Guo, **Tao Zhang**. Optimization of Remaining Useful Life for Paralleled Battery Packs on Expansion Mode. Energy Research and Power Engineering 2014, 986: 1004-1010.

[5]. Jie Meng, Yan Zhang, **Tao Zhang**. Solving Economic Dispatch Problem in Energy Internet Using a Two-level Stochastic Gossip-based Consensus Algorithm. Energy Research and Power Engineering 2014, 986: 2162-2166.

[6]. Yan Zhang, **Tao Zhang**, Bo Guo. MPC based approach for reliable power system energy management with high penetration level of renewable energy resources. Energy Research and Power Engineering 2014, 986: 371-376.

[7]. Jie Meng, **Tao Zhang**, Zhuo Huang, Yabin Zha. MAS Based Distributed Power Balancing For Multi-ELAN System. 2014 International Academic Conference on the Environment, Energy and Power Engineering 2014.

[8]. Zhifeng Zhang, Shengjun Huang, Tao Zhang, Zhuo Huang. Energy management research of Lithium-ion battery energy storage system based on SOC. 2014 International Academic Conference on the Environment, Energy and Power Engineering 2014.

Mardé Helbig is a senior lecturer at the University of Pretoria. She received her PhD degree in Computer Science from the University of Pretoria in 2012. She is the chair of the South African Chapter of the IEEE Computational Intelligence Society (IEEE CIS), a vice-chair of the Task Force on Evolutionary Multi-objective Optimization (TF-EMO) at IEEE CIS, a sub-committee member of the IEEE CIS Women in Computational Intelligence (WCI), a sub-committee member of the IEEE CIS Young Professionals, and a member of the IEEE CIS Emergent Technologies Technical Committee (ETTC).

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Selected Publications:

[1]. **M. Helbig**. The influence of topologies on the dynamic vector evaluated particle swarm optimization algorithm, *In Proceedings of the International Conference on Swarm Intelligence and Machine Learning (ISCMI)*, Dubai, UAE, 23-25 November, 2016.

[2]. **M. Helbig**. Padding the Dimensions for Knowledge Transfer in the Dynamic Vector Evaluated Particle Swarm Optimisation Algorithm, *In Proceedings of the IEEE Symposium Series on Computational Intelligence (SSCI)*, Athens, Greece, 9-11 December, 2016.

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[4]. D. Doman, **M. Helbig** and A.P. Engelbrecht. Heterogeneous Vector-Evaluated Particle Swarm

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[6]. **M. Helbig** and A.P. Engelbrecht. Using headless chicken crossover for local guide selection when solving dynamic multi-objective optimization, In *Proceedings of the World Congress on Nature and Biologically Inspired Computing (NaBIC)*, p. 381-392, Pietermartizburg, South Africa, December, 2015.

[7]. **M. Helbig.** Updating the global best and archive solutions of the dynamic vector-evaluated; PSO algorithm using ε-dominance, In *Proceedings of the World Congress on Nature and Biologically Inspired Computing (NaBIC)*, p. 393-403, Pietermartizburg, South Africa, December, 2015.

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[16]. **M. Helbig** and A.P. Engelbrecht. Analysing the Performance of Dynamic Multi-objective Optimisation Algorithms. In *Proceedings of IEEE Congress on Evolutionary Computation*, Cancún, Mexico, 20-23 June, 2013.

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