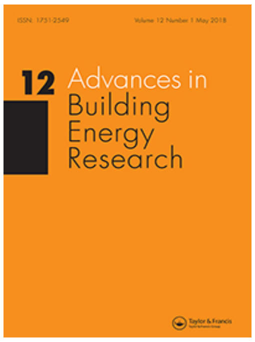

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Nick Bassiliades & Georgios Chalkiadakis

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EDITORIAL

Artificial Intelligence Techniques for the Smart Grid

In recent years, there is a rush in *Artificial Intelligence* (*AI*) *research* to produce practical solutions for the Smart Grid, the anticipated new generation of energy (primarily electricity) networks that will be able to make efficient use of renewable energy sources, support real time and efficient demand response, as well as the large-scale deployment of electric vehicles (EVs). AI techniques and methodologies can be instrumental in addressing sustainability problems, for example, to increase the efficiency and effectiveness of the way we manage and allocate our natural and societal resources. The drive to use AI for the Smart Grid has in turn led to novel questions and challenges for AI research, and to the realization that only the cross-fertilization of ideas and mixing of various techniques originating in different (sub-)fields can lead to the Holy Grail of an electricity Grid that takes full advantage of AI technologies to deliver power that is at the same time 'green', stable, affordable and accessible to all. This Special Issue brings together research questions and approaches originating in different (sub-)fields, such as multiagent systems, machine learning, optimization and statistics. As such, it provides an overview of a broad spectrum of ongoing Smart Grid research.

To begin, going beyond traditional constant electricity pricing to more complex *time of use* (*ToU*) or *real-time pricing* methods to increase efficiency in energy use, poses serious technical and socio-political questions. With multiple pricing methods available, it is important for Grid regulators, utility companies and consumers to have the means to compare and even combine such policies. Against this background, Chrysopoulos and Mitkas (2017) introduce an optimization methodology for individualized ToU pricing policies. Using a multi-objective particle swarm optimization mechanism, the appropriate rates for each implemented pricing policy are identified, leading to higher consumer acceptance rates, along with costs and peak load reduction.

At the same time, as readers of this journal know very well, a central question in Smart Grid research is modelling and analysing the energy consumption patterns of buildings. There are two articles in this Special Issue on the topic. On the one hand, Karatzas and Katsifarakis (2017) employ neural networks, decision trees and regression techniques to analyse and improve the electricity consumption of household appliances. On the other hand, Alam and colleagues (2017) provide a methodical development of thermal models using Extended Kalman Filters for parameter estimation, along with a case study using data from an actual family house.

Moving from individual house settings, Akasiadis and Georgogiannis (2017) strive to improve the effectiveness of schemes promoting the large-scale, coordinated shifting of power consumption. In particular, they provide machine learning techniques – evaluated on real world datasets encompassing thousands of users – to monitor, assess and predict the trustworthiness of individual entities participating in such demand-side management activities. Then, Kofinas and colleagues (2017) propose the use of *reinforcement learning* (*RL*), one of the three main machine learning paradigms, to optimize the operation of a solar microgrid. To this end, they present an RL automated agent that employs a "fuzzy" reward function to learn a policy towards optimizing system performance.

On a distinct issue of extremely high importance, the introduction of EVs in the Smart Grid – if accompanied with mature Vehicle-to-Grid (V2G) and Grid-to-Vehicle (G2V) technologies – is

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expected to have a significant impact on improving the 'energy mix' used for electricity generation, thus reducing carbon emissions. Ioakimidis and Genikomsakis (2017) employ a bottom-up optimization model generator to study the introduction of Plug-in Hybrid EVs (PHEVs) in an isolated islands' system in the Azores. The results obtained indicate that the integration of PHEVs providing G2V services into the local Grid can be realized without immediate technical barriers.

Last but not least, Demertzis and colleagues (2017) deal with a problem that, despite its significance, is sometimes considered to be orthogonal to the Smart Grid problems usually tackled by AI researchers: that of developing cyber-security solutions for the Smart Grid. The paper presents a system that employs soft computing approaches to model the overall security level, achieves a high level of automation for Smart Grid security strategic planning, and effective decision-making in the face of cyber-threats.

Before concluding this note, we have to mention that this Special Issue was the result of an open call for papers on its topic. Its origins, however, lie on the *Artificial Intelligence for the Smart Grid (AI4SG)* workshop that was held in conjunction with the 9th Hellenic Conference on Artificial Intelligence (SETN-16), in May 2016, at Thessaloniki, Greece. Most papers in this Special Issue are extended versions of the best papers that appeared in AI4SG.

Many individuals contributed to the success of this issue. We take this opportunity to thank all the authors for their submissions. We are also indebted to a small army of referees who have put in the hard work and the long hours to review each paper in a timely and professional way. Furthermore, we are grateful to Mr Emmanouil Rigas for his invaluable help with the organization of the AI4SG workshop and the dissemination of the call for papers for this Special Issue. Finally, we would like to express our appreciation to Professor Denia Kolokotsa, former editor-in-chief of ABER and staff members of ABER for offering us the opportunity to edit this stimulating Special Issue. We really hope that the readers of this issue will find the articles interesting and inspiring.

References

Akasiadis, C., & Georgogiannis, A. (2017). Predicting agent performance in large-scale electricity demand shifting. *Advances in Building Energy Research*, *12*, 116–137.

Alam, M., Rogers, A., Scott, J., Ali, K., & Auffenberg, F. (2017). Applying extended Kalman filters to adaptive thermal modelling in homes. *Advances in Building Energy Research*, *12*, 48–65.

Chrysopoulos, A., & Mitkas, P. A. (2017). Customized time-of-use pricing for small-scale consumers using multi-objective particle swarm optimization. *Advances in Building Energy Research*, *12*, 25–47.

Demertzis, K., Iliadis, L. S., & Anezakis, V.-D. (2017). An innovative soft computing system for smart energy grids cybersecurity. *Advances in Building Energy Research*, *12*, 3–24.

Ioakimidis, C. S., & Genikomsakis, K. N. (2017). Introduction of plug-in hybrid electric vehicles in an isolated island system. *Advances in Building Energy Research*, *12*, 66–83.

Karatzas, K., & Katsifarakis, N. (2017). Modelling of household electricity consumption with the aid of computational intelligence methods. *Advances in Building Energy Research*, *12*, 84–96.

Kofinas, P., Vouros, G., & Dounis, A. I. (2017). Energy management in solar microgrid via reinforcement learning using fuzzy reward. *Advances in Building Energy Research*, *12*, 97–115.

Nick Bassiliades
Department of Informatics, Aristotle University of Thessaloniki, Thessaloniki, Greece
nbassili@csd.auth.gr http://orcid.org/0000-0001-6035-1038

Georgios Chalkiadakis
School of Electrical and Computer Engineering, Technical University of Crete, Chania, Greece
gehalk@intelligence.tuc.gr http://orcid.org/0000-0002-0716-2972
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