

Data-driven Control Algorithms for Energy Storage applications

Summary

The effective integration of energy storage technologies requires advanced control strategies that can adapt to dynamic energy demands, weather conditions, price fluctuations, etc. This PhD position offers a unique opportunity to drive innovation in the development of machine learning and artificial intelligence algorithms tailored to optimize energy utilization, reduce costs, and enhance sustainability, for example, in the context of smart building environments. By prioritizing explainable AI capabilities, the research aims to bridge the gap between complex algorithm outputs and human-understandable decision-making processes, fostering trust and acceptance among different focus groups.

Research field:	Information and communication technology
Supervisor:	Prof. Dr. Juri Belikov
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Software Science
Application deadline:	Applications are accepted between October 01, 2024 00:00 and October 25, 2024 23:59 (Europe/Zurich)

Description

We are seeking a prospective PhD candidate who will work on developing novel data-driven and XAI-based control algorithms for energy storage applications. The successful candidate will focus on exploring how AI, machine learning, and data science can be leveraged to create optimal control methods with the following general objectives:

- Develop cutting-edge ML/AI algorithms specifically designed for optimal control of energy storage units.
- Enhance model explainability to enable different users to understand and trust the decision-making process of the control algorithms.

Main responsibilities of the prospective PhD candidate:

- Publish and present scientific articles top-tier journals and international conferences.
- Assist in relevant teaching activities and co-supervise students.
- Contribute to the goals of the Centre of Excellence in Energy Efficiency (ENER grant TK230) funded by the Estonian Ministry of Education and Research.

Requirements:

- M.Sc. degree or equivalent in Computer Science, Mathematics, or a related field.
- Clear interest in the research topic, demonstrated through a motivation letter, supported by the research plan.
- Proficiency in Python and MATLAB programming.
- Excellent English communication skills, both written and verbal.
- Strong analytical and research skills.
- Capacity to work independently and collaboratively in an international team.
- Optional: Experience with ML and AI, showcased through GitHub projects.

References:

- [1] R. Machlev, N. Zargari, N.R. Chowdhury, J. Belikov, and Y. Levron. A review of optimal control methods for energy storage systems - energy trading, energy balancing and electric vehicles. *Journal of Energy Storage*, 32, p. 101787, 2020. DOI: 10.1016/j.est.2020.101787.
- [2] R. Machlev, L. Heistrene, M. Perl, K. Y. Levy, J. Belikov, S. Mannor, and Y. Levron. Explainable Artificial Intelligence (XAI) techniques for energy and power systems: review, challenges and opportunities. *Energy and AI*, 9, p. 100169, 2022. DOI: 10.1016/j.egyai.2022.100169.



[3] Y. Levron and J. Belikov. Control of Energy Storage Devices Under Uncertainty Using Nonlinear Feedback Systems. *IEEE Power & Energy Society General Meeting*, Montreal, QC, Canada, 2020, pp. 1-5, DOI: 10.1109/PESGM41954.2020.9281879.



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