

# Methodology for Diagnostics of Energy Storage Systems Based on System Digital Representation

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## Summary

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*The PhD candidate will learn about the Digital Twin (DT) concept and its possible application in portable Energy Storage Systems (ESS) within this thesis. Department will provide the necessary equipment to develop a test bench and DT. Candidate will be responsible for developing, verifying, and implementing the models of different ESS components.*

Research field:	Electrical Power Engineering and Mechatronics
Supervisors:	Anton Rassölnkin Toomas Vaimann
Availability:	This position is available.
Offered by:	School of Engineering Department of Electrical Power Engineering and Mechatronics
Application deadline:	Applications are accepted between September 01, 2021 00:00 and September 30, 2021 23:59 (Europe/Zurich)

## Description

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### The main tasks of the thesis are:

1. State of the art in the field of portable ESS digitalization and diagnostics
  1. A modern trend for industry digitalization brings new demands for developing and applying the modeling and simulation approach. The DT aspect indicates a connection between the physical object and the corresponding virtual twin established by generating real-time data using physical and virtual sensors. The literature analysis must be provided to define the digitalization level of ESS.
  2. At that step, the study on possible ESS failures must be provided, and the solutions for the faults simulation in the laboratory suggested.
2. Development of testbench that imitates main ESS failures
  1. The ESS is a rather complex system for accurate mathematical description, monitoring, and validation. The laboratory studies with test benches, combining the advantages of software models and real equipment, contribute to the reduction of the number of test runs and safe maintenance. By using a variety of different test benches, separate parts of an ESS could be studied and improved.
  2. The test bench that allows evaluating energy management, optimal control configuration, a combination of different energy sources, etc., would be an added value to the research and development community.
3. Development of the models of main components of ESS
  1. Develop physical models of different energy system components and the related reduced models of these components, which will construct the system's DT.
  2. Develop and implement the concept of Virtual Sensors based on the developed DT concept and diagnostics methodologies based on the proposed models.
4. Methodology for creating the DT for ESS
  1. To provide the research environment for analysis, investigation, and simulation of marketable ESS.
  2. To establish assessment and verification procedures for possible fault diagnostics to support commercial consulting, research, and testing for enterprises based on the DT concept.

### The applicants should fulfill the following requirements:

- Master's degree in electrical engineering or mechatronics
- Experience with common scientific software (e.g., Mendelay, LateX, Matlab, Agros, etc.)
- Practical experience with electrical drives
- Practical experience with publishing and presenting research works (e.g. conference papers)
- Very good command of English

- Fluent Estonian language skills in written and oral are eligible



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