

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Fernando Dávalos Hernández

PhD Program: Engineering Systems

Title of Thesis: Supercapacitor Energy Storage System based on Modular Multilevel Converter with embedded self-balance control

Supervisor: Associate Professor Federico Martin Ibanez, Skoltech

Name of the Reviewer:

<p>I confirm the absence of any conflict of interest</p> <p>(Alternatively, Reviewer can formulate a possible conflict)</p>	<p>Date: 15-08-2023</p>
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The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

This thesis focuses on analysis and design of a specific energy storage system by adopting the modular multilevel converter. The novelty of this work resides in the selection, design of the power converters and the proposed techniques to use them as balancers, DC/DC, and DC/AC converters simultaneously. The author makes a detailed literature review, develops the model of the system, builds two laboratory prototypes (with single supercapacitor per submodule and with 4 supercapacitors per submodule) and provides its experimental validation.

The described research is performed at high international level and is consistent with current state-of-the-art in the area of power electronics and – more wider – energy systems. The results are published in several conference proceeding including one journal paper.

The structure of the thesis is pretty standard. After comprehensive introduction and literature review the main contributions are described in Chapters 3 and 4, conclusions are summarized in Chapter 5.

Some comments:

- Thesis contains a lot of acronyms. I suggest to make a list of acronyms in the beginning.
- In the thesis significant attention is devoted to the number of SC per SM. So what is the optimal number SC per SM? Will it depend on particular application?
- One of the declared benefits of the proposed design is the reduction of losses. What is the actual losses reduction (both theoretical and experimental)? What is the proper way to assess the reduction of losses?
- Table 6 reports the characteristics of each SM with an efficiency of ~94%. Where this efficiency comes from?

Provisional Recommendation

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense