

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Oleg Khamisov

PhD Program: Engineering systems

Title of Thesis: Optimization of Frequency Control in Power Systems

Supervisor: Assistant prof. Anatoly Dymarsky

Co-advisor: Prof. Janusz Bialek

Date of Thesis Defense:

Name of the Reviewer:

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	Signature: Federico Ibanez Date: 17-03-2017
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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

The thesis presented by Oleg Khamisov has is a very good contribution to the state of the art of grid control. It covers deeply many aspects of frequency control with bounded control limits and in addition, adds two other important aspects: power congestion in power lines and inter-area power flow control.

He claims that the main contribution is the second order model or the turbine-governor. The model is not new but the contribution is the use of this model in the whole system. Using this model, it can be proved that the grid can be stable or not. Simpler models are always stable due to the larger phase margin in the loop.

In my opinion, the thesis is a good contribution, however, the presentation of the content is not so clear. The organization of the thesis structure and the quality of the text and description can be improved. Nevertheless, I consider that the core of the thesis is valuable.

The thesis is compared with the state of the art in chapter 2 and 3 and its contribution is clear: the second order model, proof of stability and distribution control for grid frequency, which includes other important aspects as inter-area power flow and congestion controls.

Unfortunately, Oleg has presented many of his results mainly in conferences. The main journal paper that he has is not very related to the topic of the thesis and the MIPT journal is difficult to find. My suggestion is to take advantage of his knowledge and publish journal papers as soon as possible.

Some comments that can improve the thesis are:

- I appreciate to define Karush-Kuhn-Tucker (KKT) conditions
- What is a Primal-dual type approach? A diagram explaining how it works will help readers.
- I found chapter 2 upside down first the list of papers and then how to group them. Also I suggest to start with chapter 6 describing the system and then explain the other authors contributions so the reader already knows the base of the thesis. This is related to the restructure of the thesis.
- In the first chapters you mentions the problems just by numbers, I suggest to use a name related with the problem. (table 3)
- The notation is quite confusing, I suggest that from time to time refresh some notations as σ \wedge etc.
- More simulations and experimental results will add some engineering value.
- The figures are not carefully made, some of them do not have y-axis label, some of them are in Russian, the caption below the figures are not descriptive enough, and some legend are not consistent with the text. For example Fig. 12.7
- Please check Lemma 12.13 If $x_1 > x_2$, then $Y_2 < 0$
- In (12.10) $u = -W^{-1}n\wedge\lambda$, from (12.8) but in (13.8a) is $W\wedge u = \wedge\lambda$, please check if the signs are correct. In general, check carefully the math.
- I would appreciate if the term disturbance is also mentioned as the power consumption if this is the case
- I would appreciate a detail explanation about the integral of the perturbation and estimation of that.

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